THE MECHANISM OF FIRE Made in CHIMNEYS:

OR, THE ART of improving the EFFECTS and diminiſhing the EXPENCES thereof.

CONTAINING

A Treatiſe of New-invented CHIMNEYS, that afford more Heat than the others, and are not ſubject to Smoak, *&c.* ſet forth in *French* by *Monſr. Gauger:* The entire Work faithfully Tranſlated into *Engliſh*, from the laſt *Paris*-Edition, and Revis'd by ſeveral skilful Artiſts, ſo as to render it ſuitable to the *Genius* and *Capacity* of our Workmen.

To which is added,

All the Author's Original Draughts corrected and fairly engraved on Copper-Plates, with a large Alphabetical Table, explaining near Two Hundred Terms of Art, and other hard Words in the Treatiſe.

LONDON:

Printed for *R. Bonwicke, Tim. Goodwin, J. Walthoe, M. Wotton, S. Manſhip, J. Nicholſon, R. Wilkin, B. Tooke, R. Smith* and *T. Ward.* MDCCXVI.

THE

PREFACE.

PErſons *that only judge of the Value of Machines by the vaſt Efforts of* Genius *which are requiſite for inventing them; by the great Number of Springs that ſet them a going; by the Difficulty of erecting and bringing them to Perfection; or by the Time and Charges ſpent in putting them in Motion; cannot expect to find theſe Contrivances here produc'd, agreeable to their Taſte: But they that take an Eſtimate of ſuch Devices from the Simplicity of their Conſtruction, and the Facility of their Execution; or from the Conveniences, Profits and Advantages thence ariſing; may, upon many Accounts, prefer theſe New-invented Chimneys, before abundance of other more ingenious Undertakings.*

A Plate of Iron or Copper bow'd or bended after ſuch a manner as is not at all diſagreeable to the Sight; a Void behind, divided by certain ſmall Iron-bands or Partition-plates, forming ſeveral Spaces, that have a Communication one with another; a little Vent-hole in the middle of the Hearth, a Regiſter-plate in the upper part of the Funnel; and for ſome Shafts, a Capital on the top, make up the whole Conſtruction and Workmanſhip of our Modern Chimneys: Now can there be any Thing more ſimple or plain, or more eaſy to execute?

To be able to kindle a Fire ſpeedily, and make it (if you pleaſe) flame continually, whatever Wood is burning, without the uſe of Bellows; to give Heat to a ſpacious Room, and even to another adjoyning, with a little Fire; to warm one's ſelf at the ſame time on all ſides, be the Weather ever ſo cold, without ſcorching; to breath a pure Air always freſh, and to ſuch a degree of Warmth as is thought fit, to be never annoy'd with Smoak in one's Apartment, nor have any Moiſture therein; to quench by one's ſelf, and in an Inſtant, any Fire that may catch in the Tunnel of a Chimney: All theſe are but a few of the Effects and Properties of theſe wonderful Machines, notwithſtanding their apparent Simplicity and Plainneſs. What is there then, I pray, more commodious, more uſefull, or even more neceſſary?

But farther, divers Mathematical Demonſtrations, and Philoſophical Arguments ſhall be produc'd, to account for theſe Effects, and ſome others of the like Nature; and as for thoſe Gentlemen who require Experimental Proofs, I here declare, that ſince I us'd this ſort of Chimneys, every

Year

Year has confirm'd to me by new Tryals, the certainty of all these extraordinary Events. I have not been troubled one Moment with Smoak in a Lodging, which it render'd before untenable, as soon as a Fire was lighted; I have always taken in (even during the sharpest Seasons) a fresh Air, like that of the Spring. In 1709, Water that froze hard every where else very near the Hearth, did not congeal at Night in my Chamber, tho' the Fire was put out before Midnight; and all that was brought thither in the Day, soon thaw'd; neither did I ever perceive the least Moisture in Winter, not even during Thaws of the longest continuance.

Nevertheless we dare not engage, that all Persons dispos'd to have these Chimneys, shall receive the same Advantages: It is requisite for this Purpose, that they cause them to be built after the Manner, and according to the Proportions hereafter laid down; for some will be apt to omit several Particulars, and others to alter them; so that in endeavouring to add certain imaginary Conveniences, they'll absolutely deprive themselves of many real ones, and perhaps of those that are the most advantageous and needful; as has already happen'd, in many Instances which might be given.

*The earnest Desire several Gentlemen of Worth and Note have express'd to enjoy the Conveniences of these Chimneys; the fruitless expensive Attempts that have been for some time made * in order to attain them; and the Sollicitations of*

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* Some Months ago certain Persons took upon them to Counterfeit in several Places some part of these Chimneys; without truly apprehending the Construction of them, and without having a sufficient Knowledge either of their Properties or Effects.

several

ſeveral Friends, are the Motives that induc'd us to Publiſh this Treatiſe.

The whole Work is divided into three Books: In the firſt, we explain how theſe Chimneys ought to be diſpos'd; as alſo their Properties with reſpect to Heat, Conveniences, Advantages, &c. *and in a Word, all their Effects; and then we ſhew how theſe Events reſult from ſuch Diſpoſitions.*

In the ſecond Book, the Reader is inform'd upon what account, and in what manner the ſaid Diſpoſitions abſolutely take away the Annoyance of Smoak; explaining the Cauſes and Effects of that troubleſome Vapour.

In the Third Book, which conſiſts of Matters altogether Practical, we lay down ſeveral different Conſtructions of theſe new-invented Chimneys, (ſome of which are more ſimple or plain than the others) with the Manner of putting them into Uſe and Practice. In this Performance, endeavours have been us'd to render every Thing ſo intelligible, that the Workmen may in all reſpects underſtand and do by themſelves, what is here propos'd.

It is alſo our Intention, in proceſs of Time, to ſet forth the ſecond and third Parts of this Mechaniſm, one of which is to contain, A Treatiſe of New-invented Stoves, *which tho' not different from the ordinary Ones in Appearance; will have none of their Inconveniences, but afford more Heat, and burn faſter, with leſs Fire; the Sight of which they'll leave free without Smoaking; and cauſe the Perſons in the Room, to breath an Air that is continually freſh, and to ſuch a degree of Warmth as ſhall be thought fit, without either augmenting or diminiſhing the Fire.*

In

In the other Part, we ſhall give the Conſtruction of certain new and very plain Devices, that will ſave a great deal of Pains, Time, Fuel, and Expence, for Dyers, Brewers, Bagnio-keepers, Whitſters, &c.

Notwithſtanding what is here ſaid with reſpect to theſe two Treatiſes, the World is not to expect that they will be ſuddenly Publiſh'd; ſince they ſtill require ſeveral Experiments, with which indeed we ſometimes divert our ſelves; tho' very ſeldom: And foraſmuch as the Reader may find in this firſt Treatiſe, the Principles of the two others that are to follow; if any ingenious Perſons are diſpos'd to give themſelves the Trouble of applying to this Study, we ſhall take a great Satisfaction in communicating to them whatever we have already invented, or may hereafter find out, for the Conſtruction of theſe Works, to the end that the Publick may reap the Benefit thereof ſo much the ſooner.

In theſe Treatiſes ſuch Principles are likewiſe to be met with, as will furniſh Means for keeping Rooms continually cool, during the moſt exceſſive Heats; and yet all Perſons in them may breath an Air always freſh and healthful.

ADVER-

ADVERTISEMENT.

THOSE Persons who are not well skill'd in *Geometry*, may pass over the few Particulars relating to that Science in this Treatise, and the rest will not be in any wise the less intelligible; especially if they have recourse to the following Alphabetical TABLE, in which all the TERMS of ART in *Natural Philosophy*, *Physick*, *Anatomy*, *Surgery*, *Geometry*, *Architecture*, *Masonry*, *Carpentry*, &c. with divers Original *French*, and other hard Words, here made use of are particularly and clearly explain'd.

A TABLE OF THE TERMS of ART, &c.

A.

A *Bſciſſæ* (Lat. in a *Conick Section*) are the parts of the *Axis* cut off by the *Ordinate*, and counted downward from the *Vertex* or top of the Section.

Æolipylæ or *Æolopylæ*, (*q. d.* Wind-gates) Devices anciently made uſe of to help ſmoaking Chimneys; from the *Greek* Words *Æolus*, the fabulous God of the Winds, and *Pylæ*, a Gate: Certain Balls, or Pipes of Braſs, which being fill'd with Water, and ſet over the Fire, the Water ſteaming out ſtrongly, carry'd up the Smoak, together with its Vapour.

To *Agitate*, (Lat.) to tumble and toſs, to debate a Matter: In Philoſophy, to raiſe or ſtir up; as *Fire* or *Heat* agitates *the Particles or ſmall Parts of all Bodies*, and puts them into a ſwift Motion.

Agitation, an agitating, violent Motion, or joulting; diſquiet of Mind, the management of a Buſineſs in hand: In a *Philoſophical Senſe*, the brisk inward Motion of the *Cörpuſcles*, or very ſmall Parts of any Natural Body.

Agnus Dei, (*i. e.* the Lamb of God) a Figure of the Holy Lamb with a Croſs ſtamp'd on a

piece of white Wax, and bleſs'd by the Pope, in order to be given or ſold as a precious Relick.

Animal, living that belongs to Life, that has Life in it; as *The Animal Spirits.*

An *Animal*, a Living-Creature, any thing that has Life and Senſe; as a Man, a Beaſt, a Bird, a Fiſh, *&c.*

An *Aperture*, an Opening, a Hole; in *Architecture*, a Hole or Paſſage in a Building.

Aqueous, belonging to, or like Water, watery or wateriſh.

An *Arch*, (in *Architect.*) is any hollow Building rais'd with a Mould in form of a Semi-circle; as an Arch of a Gate, Window, Bridge, *&c.* In *Geometry*, an *Arch* or *Ark* is any part of the Circumference of a Circle; or crooked Line lying from one Point to another; by which the Quantity of the whole Circle or Line, *&c.* ſought after may be gather'd.

The *Atmoſphere*, (*Greek* in *Philoſ.*) that Region or Space of Air round about the Earth, into which Exhalations or Vapours are rais'd by Reflection from the Sun's Heat, or otherwiſe.

Attractive, (*Lat.*) that is apt to attract or draw to one's ſelf.

Axis, the Axle-tree of a Cart, Waggon, or Coach: In *Geometry*, a ſtraight Line conceiv'd to proceed from the *Vertex*, or top of a Figure to the *Baſe* or Bottom.

B.

Band, ſee *Languette.*

A *Barometer*, (*Greek q. d.* Meaſure of Weight) an Inſtrument invented to find out the leaſt Variations of the Weight of the Air, and thence to diſcover its future Temper, with reſpect to fair or foul Weather: It conſiſts of a long Glaſs-pipe ſeal'd up at one end, which being almoſt fill'd with Quick-ſilver, is turn'd upſide-down, ſo as the open end of it may reſt in Quick-ſilver contain'd in a larger Glaſs underneath, and expos'd to the preſſure of the outward Air.

Baſe or *Baſis*, the Bottom of any thing, eſpecially of a Geometrical Figure.

Baſcule, (*French*) a Device ſo held up in the middle of an *Axis*, that when any Thing is laid upon one ſide, the other riſes: It is here taken for a Regiſter-plate fixt at the bottom or top of a Chimney, to quench Fire that has catch'd in the Funnel, to keep out Smoak, *&c.*

The *Breaſt* (of a Chimney) the fore-part of it above the Mantle-piece.

C.

A *Canal*, (*Lat.*) an artificial River for the draining of fenny Grounds, a Paſſage for Water cut from one Place to another; it is here apply'd to ſignify a Paſſage for

for the Air in Pipes along the Sides, Back, Breaſt, or Ground-plot of a Chimney.

A *Capital*, the Head, Crown, or upper-part of a Pillar: But 'tis here taken for a Device fixt on the top of the Shafts of ſome Chimneys, in order to give a free Paſſage for the Smoak to iſſue out and hinder the ent'rance of the Wind.

Catoptricks, that part of the Science of *Opticks*, which ſhews after what manner Objects may be ſeen by Reflection; and alſo explains the Cauſes, Laws and Properties of it.

Celerity, Swiftneſs, Speed, Diſpatch.

A *Cell*, the Habitation or Hut of a Hermit, the Partitions in Monaſteries where Monks lye are alſo call'd *Cells*; but the Word is here taken for certain Hollows on the inſide of a Chimney.

A *Center*, the middle Point of any thing, eſpecially of a Circle or Sphere, from whence all Lines drawn to the Circumference are equal one to another. In *Maſonry*, a wooden Mould to turn an Arch.

Cent'red, made in form of a Center or Arch.

Chambranle, *(French)* an Ornament in *Maſonry* and *Joyners-work* which borders the Sides of Doors, Windows and Chimneys; the Mantle-piece of a Chimney: It is different according to the ſeveral Orders of Architecture, and made up of three Parts, *viz.* the top call'd the *Traverſe*, and the two Sides the *Aſcendants*.

Chimney-piece, that croſs-piece of Timber which lies over the Jambs or Sides of a Chimney on the in-ſide.

A *Circle*, *(Lat.)* a Compaſs, a Ring. In *Geometry*, a plain Figure, comprehended only under one *Curve* or crooked Line, and having a Point in the middle of it call'd the *Center*.

Circumference, Circuit or Compaſs: In *Geometry*, that Line which goes about, and encloſes the *Area*, or content of a Circle; it is alſo ſometimes taken for the outermoſt bounding Line of any other Plain Figure.

A *commanded Chimney*, one that is over-look'd by ſomething that ſtands above it; as any higher Building, the ſide or top of a Hill, a Flag, *&c.*

A *Complement*, *(Lat.)* a filling up or perfecting that which wants, the Number which a whole Sum amounts to.

Complicated, wrapt up together, compound or made up of ſeveral Things.

Concave, hollow on the inſide, or vaulted like an Oven.

A *Concave*, a Hollow, or hollow Space: Among *Brick-layers*, a Plate of Iron, or other Metal, that is ſometimes ſet ſloaping in the Breaſt of a Chimney to ſtraighten it, and make a Hollow on the in-ſide.

Concavity, the inſide Hollowneſs of a round Body.

To *Condenſe*, to thicken, to make thick, or to grow thick: In *Philoſophy*, to bring the Parts of a Natural Body into a narrower Compaſs; the oppoſite Term being to *Rarify*.

A *Cone*, *(Gr.* in *Geometry)* a Solid Figure, conſiſting of ſtraight Lines that ariſe from a Circular Baſe, and grow narrow by Degrees, till they end in a Point at the top, directly over the Center of the Baſe.

Conick Sections, are certain Diviſions of the ſolid Body of a Cone, ſuppos'd to be cut by a Plane: Theſe Sections are generally counted three in Number, and call'd *Ellipſis*, *Hyperbola*, and *Parabola*.

Contiguous, that touches, or is next to, cloſe adjoyning, very near.

Convex, bending down on every ſide like the Heavens, or the out-ſide of a Globe, or round Body.

Convexity, the Crookedneſs, and bending or bowing of a thing downward on the out-ſide, contradiſtinguiſh'd from *Concavity*, which is on the in-ſide.

A *Crane*, ſee Siphon.

A *Crayon*, *(Fr.)* a ſmall Pencil of any ſort of colouring Stuff made up into Paſte and dry'd, to be us'd in drawing or marking in dry Colours upon Paper or Parchment.

Curvature, *(Lat.)* a Bowing or Bending, Crookedneſs.

A *Curve*, or *curved Line*, *(*in *Geometry)* is a crooked Line.

Curvilineal or *Curvilineary*, crooked-lined; as *Curvilineal Figures*.

Cuticle, *(*in *Anatomy)* the Scarf-Skin, or outermoſt thin Skin, which covers the whole Body, and is full of innumerable *Pores*, or very ſmall Holes, for the Paſſage of Vapours, Sweat, *&c.*

A *Cylinder*, a Roller or Rolling-Stone: In *Geometry*, a ſolid Body made by the turning of a Rectangled Parallelogram about one of its Sides; ſo that it is extended in Length, equally round, and its Extremities or Ends are equal Circles.

D.

To *Demonſtrate*, *(Lat.)* to ſhew plainly, to prove evidently or unanſwerably.

A *Demonſtration*, a demonſtrating or making plain, a clear Proof: In *Mathematicks*, a Chain of Arguments depending one upon another, and originally founded on ſelf-evident Principles, or plain Propoſitions, raiſed and proved from them, ſo as at laſt it ends in the undeniable Proof of the Thing to be demonſtrated.

To *Depreſs*, to preſs, thruſt, or weigh down.

To *Deſcribe*, to write or ſet down in Writing, to repreſent, to explain: In *Geometry*, to draw a Line, a Circle, *&c.*

Diameter, *(Gr. i. e.* the meaſuring Line

Line in *Geometry*) is a Line that passes thro' the middle of any Figure, from one Angle or Corner to another.

Dimension, (*Lat.*) the just Measure or Proportion of any Thing: In *Geometry*, Length, Breadth and Thickness, or Depth, are termed the three Dimensions: Thus a Line is said to have one Dimension, *viz.* Length, a Surface two, *viz.* Length and Breadth; and a Solid or Body, has all three Dimensions.

To *Dilate*, to widen, to grow wide, to stretch; to rarify, or grow thin, as the Air does.

Diminution, a diminishing or lessening; abatement, decrease.

Disposition, the Act of Disposing, Order, Situation, State, Aptness: In *Architecture*, it is the just placing of all the several Parts of a Building, according to their proper Order.

Draught, (of a Chimney) the falling in above the Back.

E.

Egress or *Egression*, (*Lat.*) a going forth; as to have free Egress and Regress.

Elasticity, (*Gr.* in *Philosophy*) a Power to return to its first Place or Condition, as a Stick that is forcibly bent.

Elastick, or *Elastical*, that has or belongs to such a Quality; that recoils with a kind of Spring or Force.

Elastick Force, originally signifies the Force of a Spring when bent, and endeavouring to unbend it self again. This Quality is attributed by *Philosophers* to the Air, &c.

To *Elevate*, (*Lat.*) to raise or raise up, to exalt or lift up.

Elevation, the Act of elevating, raising, or lifting up.

Ellipsis, (*Gr.* in *Geometry*) a plain Figure, commonly call'd an *an Oval*; or a crooked Line including a Space longer on one side than the other, and drawn from two Center-points, each termed the *Focus*, or Navel; being one of the three Sections of a Cone.

Elliptical, belonging to such a Figure.

Equidistant, (*Lat.*) that is of an equal Distance.

To *Erect*, to raise or set up, to build.

Ethereal, (*Gr.*) belonging to the Heavens, Sky, or Air.

To *Exhale*, (*Lat.*) to cast or send forth a Fume or Vapour; to breath out, or steam.

An *Exit*, a going forth, a departure.

Exteriour, more outward.

External, that is on the outside, outward.

Extragenous, (in *Anatomy* and *Surgery*,) that is of a foreign Kind, as *an Extragenous Body*.

Extremity, the end, edge, brink, skirt, or border of a Thing.

Fibers,

F.

Fibers, or *Fibres*, the Threads, or hair-like Strings of Muſcles, Veins, Plants, Roots, *&c.*

Flexible, that may be bowed or bent, pliable.

Focus, *(Lat.)* a Hearth or Fire-place. In *Geometry*, there are two *Focus*'s or Navel-points in an *Ellipſis*, or Oval, which ſerve for the drawing of that Figure, and from whence, if two Right-Lines be drawn to any Point of the Circumference, the Summ of them is is equal to the Tranſverſe or longer *Axis*.

Focus, (of a *Parabola)* is a Point in the *Axis*, within the Figure, diſtant from the *Vertex* or top one fourth part of the *Parameter*: 'Tis call'd *the Focus*, as being the Point, in which the Sun's Rays are united, when reflected from a *Parabolick Concave*, ſo as to ſet Fire on Natural Bodies; whence by ſome it is termed, the *Burning point*.

A *Funnel* or *Tunnel*, an Inſtrument to convey Liquors into a Veſſel; in a *Chimney*, the upper Part above the Breaſt and Sides.

G.

Gravity, *(Lat.)* Graveneſs, Soberneſs, Diſcretion: In a *Philoſophical Senſe*, Weight; or that Quality, by which all heavy Bodies tend toward the *Center* or Middle-point of the Earth, haſtening their Motion, as they come nearer towards it.

H.

Horizon, (Gr. in *Aſtronomy)* is a great Circle of the Sphere that divides the *upper Hemiſphere*, or Half-compaſs of the Heavens, which we ſee from the *lower Hemiſphere* which is under us, and hid from our Sight: Or it is that great Circle which bounds the Sight of any Perſon, who being ſet in a large Plain or in the midſt of the Sea, looks round about, and by which the Heavens and Earth ſeem to be joyn'd as it were with a kind of Cloſure. This Circle takes Name from the *Greek* Word *Horizo*, i. e. to terminate or bound.

Horizontal, belonging to, or lying even with the Horizon.

Hotte, *(French)* a Dorſer, a kind of Basket wide at top and narrow at bottom, to carry Things on Horſe-back; the Draught or falling in of a Chimney: 'Tis alſo ſometimes here taken for the Breaſt of a Chimney, eſpecially that part of it which lies about the Concave or Hollow.

I.

Jambs or *Jaumbs*, the Side-poſts of a Door, or the Side-walls of a Chimney.

To *Imbibe*, *(Lat.)* to drink or ſuck in; to receive by Education.

Inanimate, that has no Life or Soul, Lifeleſs, Dead.

Inclina-

Inclination, Natural Diſpoſition, Proneneſs, Aptneſs: In *Geometry*, the mutual tendency or leaning of two Lines, or two Planes towards each other, ſo as to make an Angle.

Inclined, bowed or bent to, leaning towards.

Indented, notched, jagged.

Index, a Token or Mark to direct or ſhew, as the Hand of a Clock, the Pins that direct to Figures on ſeveral Inſtruments; the Table of Matters contain'd in a Book.

Ingreſs, an Ent'rance upon, or going into.

Interiour, more inward being on the inſide.

Internal, that is within, inward.

Interval, a Diſtance or Space, either of Time or Place.

Iſinglaſs. See *Talk*.

L.

Languette, (*Fr.*) a little Tongue, the little Pipe or Tongue of ſome Muſical Inſtruments: It is here taken for a ſmall Partition. *Languettes* are alſo certain ſmall narrow Bands or Plates of Iron, which being bent and clos'd up make the Pipes that ſerve to convey the Air in the Hollows behind the Sides, and Back or under the Ground-plot of theſe new-invented Chimneys, or in the Funnels of thoſe that are made winding.

Levity, (*Lat.*) Lightneſs, Fickleneſs, Inconſtancy: In *Natural Philoſophy*, it is the leſſening or want of Weight in a Body, when compar'd with another that is heavier, and in this Senſe 'tis oppos'd to *Gravity*.

A Line, part of the Matter contain'd in a Page or Column that is written or printed: In *Geometry*, it is a Quantity ſtretch'd out in length, but ſuppos'd to be void of Breadth and Depth, being made by the Motion of a Point, from one Place to another.

Luminous, full of light, bright.

M.

A *Machine*, (*Fr.*) any Engine, Contrivance, or Device made of ſeveral Parts, ſet together by Mechanical Art; as Wheels, Springs, &c. to raiſe or ſtop the Motion of Bodies, for many Uſes in Architecture, Fortification, Warlike Atchievements, Water-works, &c.

The *Mantle-piece* (of a Chimney) the ornamental Frame of Timber or Maſon's-work that is fixt before the lower *Aperture*, or Opening at the bottom on the outſide. See *Chambranle*.

Maſtick, (*Gr.*) a clear and ſweet Gum iſſuing out of the Maſtick or Lentisk-tree: Alſo a Compound of Wax, Roſin and Brick-duſt, made uſe of by Joyners and Lapidaries.

Mechanical or *Mechanick*, belonging to the Mechanicks.

Mechanicks, the Science of Motion, or that Part of the Mathematicks

maticks which ſhews the effects of *Powers* or moving Forces, and applies them to Machines or Engines, demonſtrating the Laws of Motion, *&c.* 'Tis alſo commonly taken for thoſe Handy-crafts, in which the Labour of the Hands is requiſite, as well as the Study of the Brain.

Mechaniſm, a Diſpoſition, Make, Property, or Quality ſuitable to the Principles of *Mechanicks*.

A *Moment*, *(Lat.)* an Inſtant, the leaſt part of Time that can be aſſign'd.

A *Muſcle*, a Shell fiſh: In *Anatomy*, a Part of the Animal Body made of Fibres, Fleſh, *&c.* which is the chief Inſtrument of voluntary Motion; and conſiſts of a Head, Belly and Tail: The Head of a Muſcle is its beginning, always fixt to the moſt firm Part; the Belly being its Middle Part, is ſwell'd or ſtretch'd out in all Motion; and the Tail is the other Extreme or End, which is faſten'd into the Part to be moved.

N.

Nauſea, *(Lat.)* properly a being Sea-ſick, a Qualm or liſt to to vomit, with Sickneſs and Uneaſineſs; loathing.

O.

To *Obſtruct*, (properly to ſtop up by building againſt) to ſtop or ſhut up, to hinder.

Obſtruction, an Obſtructing, a Stoppage, a Hinderance.

An *Ordinate* (in a *Parabola*) is a Line drawn thro' the *Axis* and *Diameters*, parallel to the Tangent: Half this Line is alſo ſometimes call'd *the Ordinate*, and the whole the *Double Ordinate*.

To *Operate*, to work, or ſtir the Humours of the Body, as Phyſick does; to effect, or bring to paſs.

Operation, an Operating or Working; a Proceſs or Work carry'd on in Chymiſtry, or Surgery, *&c.*

P.

Parabola *(Gr.)* the comparing of Things together, a Parable or Similitude: In *Geometry*, one of the three Conick Sections, which ariſes from a Cone's being cut by a Plane parallel to one of its Sides, or parallel to a Plane, that touches one Side of the Cone.

Parabolical or *Parabolick*, belonging to a Parable or to a *Parabola*.

Parallelogram, (in *Geometry*) a quadrilateral or four-ſided Figure; the oppoſite ſides of which are parallel; ſo that the Term may be apply'd to the *Square*, *Oblong* or Long Square, *Rhombus* and *Rhomboid*.

Parameter or *Latus Rectum* (in *Conick* Sections) is a third Proportional to the Line call'd *Abſciſſa*, and any Ordinate of a *Parabola*: The Term is alſo us'd in the *Ellipſis* and *Hyperbola*; but there it has a different Proportion.

A *Particle*

A *Particle* (in *Grammar*) a ſmall undeclined Word: In *Philoſophy*, a very ſmall Part of Matter.

A *Pivot*, (*Fr.*) a piece of Iron made for the moſt part, like a Top, round and broad at one End, and ſharp at the other, by which means it is let into the *Crepaudine*, and ſerves as well to bear up a Gate (in the bottom of which it is fixt) as to facilitate the Motion thereof.

A *Plane*, a Joyner's Tool to ſmooth Boards with: In *Geometry*, a *Plane* or *Plain Surface* is, that all the Parts of which lye even between its Extremities or bounding Lines, and it is the ſhorteſt Reach from one Line to another, as a Right Line is the ſhorteſt Extenſion from one Point to another.

A *Point*, a Mark of Diſtinction: In *Geometry*, it is defined to be the beginning of Magnitude, and conceiv'd ſo ſmall, as to have no Parts; being the ſame in Quantity as a Unite in Number.

A *Pole* (in *Mathematicks*, from the *Greek* word *Poleo*, to turn) is a Point 90 Degrees diſtant from the Plane of any Circle, and in a Line perpendicularly rais'd in its Center, which Line is call'd the *Axis*. *The Poles of the World*, are the two Ends of the imaginary *Axis* or Right-line, about which the Sphere of the Univerſe is conceiv'd to move or turn.

Pores (in *Philoſophy*) are ſmall void Spaces between the Particles of Matter, of which all Bodies are made up.

Pores (of the *Skin*) certain Holes ſo ſmall that they cannot be perceived, wherein the Hair grows, and thro' which Sweat, with other Humours and Vapours paſs out inſenſibly.

Poſition, (*Lat.*) a putting or laying: In *Philoſophy*, Poſition or Site is an Affection or Property of Place, and expreſſes the manner of any Natural Body's being in a particular Place.

Preſſure, a preſſing cloſe upon.

A *Priſm*, (*Gr.* in *Geometry*) a Solid bounded by ſeveral Planes, whoſe Baſes are Polygons, equal, Parallel, and alike ſituated. A *Triangular Priſm* is a kind of Priſm, the two oppoſite Baſes of which are Triangles, alike, parallel and equal.

A *Problem*, is a Propoſition with a Queſtion annex'd: In *Geometry*, a Propoſition referr'd to Practice, and ſo oppos'd to a *Theorem*, in regard that it always implies ſomething to be done, as *To divide a Line into any Number of given Parts, to draw the Circumference of a Circle thro' ſeveral given Points*, &c.

A *Profil*, (*Ital.*) the Draught of any piece of Architecture, in which is ſet down the Breadth, Depth and Height of the whole Work; but it does not repreſent the Length which Property belongs to the *Plan* or Ground-plot. So that 'tis much the ſame with a Proſpect of a Place, City,

Building, *&c.* view'd Side-ways, and expreſs'd according to the Rules of Perſpective.

A *Pyramid*, (in *Geometry*) is a ſolid Figure, whoſe Sides are bounded by plain Triangles, that end in one Point at the top; but the Baſe may be a Triangle, a Square, a Polygon, *&c.*

Q.

A *Quadrant*, (*Lat.* in *Mathematicks*) is an Arch that contains the fourth part of a Circle, or 90 Degrees.

R.

Radius, (*Lat.*) a Ray or Beam of the Sun, or of a Star: In *Geometry*, it is the ſame with the *Semidiameter* or Half the Diameter of a Circle. See *Diameter*.

Rarefaction, rarifying, a making or becoming thin. In *Philoſophy*, Rarefaction of a Natural Body, is when it takes up more Dimenſions, or a larger Space than it did before.

To *Rarify*, to make; or to grow thin.

A *Receptacle*, a Place fit to receive or hold any Thing; a Storehouſe.

A *Rectangle*, (in *Geometry*) a right or ſtraight Angle made by the falling of one Line perpendicular upon another: Alſo a Right-lined Figure conſiſting of four Sides and as many Right Angles; but it is moſt commonly taken for a *Parallelogram* that has Right Angles, but unequal Sides; eſpecially the *Oblong* or Long Square.

To *Reflect*, to beat or ſend back Light or Heat; to return, or to redound.

Reflection, a reflecting, beating or returning back.

Reſpiration, the Act of Breathing, the taking in, and letting out of Air thro' the Wind-pipe.

Route, (*Fr.*) Road, Way, eſpecially that which Military Forces are to march thro'; it is here taken for the Courſe, or Way, the Air makes in paſſing thro' the ſeveral Conduits or Pipes laid in theſe Sorts of Chimneys.

S.

Section, (*Lat.*) a cutting or dividing; the dividing of a thing, or part of a thing divided: In *Mathematicks*, it ſignifies the cutting of one Plane by another, or of a Solid by a Plane. In *Architecture*, the *Section of a Building*, denotes the Profile or Draught of its Heights and Depths raiſed on the Plane, as if the whole Fabrick were cut aſunder to diſcover the inſide. For the Section of a Cone, See *Conick Sections*.

A *Sector* (of a Circle) is a Part of a Circle, or a mixt Triangle comprehended between two *Radius's* or Semi-diameters, making an Angle at the Center, and an Arch, or part of the Circumference.

A *Semi-circle*, one half of a Circle bounded by the Diameter, and half the Circumference.

Senſation,

Senſation, (in *Philoſophy*) the Impreſſion that Objects make upon the Senſes, or the perceiving of Things by the Senſes, from whence they are convey'd to the Underſtanding.

Serpentine Line, a crooked winding Line, going in and out like a Serpent.

The *Shaft* (of a Chimney) the upper Part of the Funnel from the Mantle-piece of the Garret or uppermoſt Room.

A *Siphon*, (*Gr.*) a Cock or Pipe in a Conduit, the Tap or Faucet of a Veſſel: Alſo a Tube or Pipe of Glaſs or Metal, which is uſually bent to an acute Angle, and has one Leg ſhorter than another: Theſe *Siphons* or *Cranes* are often us'd to draw off Liquors out of one Barrel or Veſſel into another without raiſing the Lees or Dregs; ſo that the Liquor beginning to run will continue ſo till all be empty'd, without any other force than the natural Preſſure of the Air.

Structure, (*Lat.*) Manner or Way of Building, a Fabrick or Pile of Building.

To *Subſide*, to ſink or fall low, as Liquids may do.

To *Suffocate*, to ſtop the Breath, to ſmother, ſtifle, or choak.

A *Superficies* or *Surface*, the outermoſt Part of any Thing, the Outſide: In *Geometry*, it is defin'd to be a Magnitude bounded by Lines that only has Length and Breadth, without Depth or Thickneſs.

The *Sweep*, (of a *Chimney*) the Compaſs at the bottom on the inſide, round about the Hearth, Sides and Back.

A *Syringe*, (*Gr.*) a ſort of Squirt us'd by Surgeons to convey Medicinal Liquors into Wounds, Sores, *&c.*

T.

Tablette, (*Fr.*) a Shelf, a Hanging-ſhelf: In a Chimney a wooden Plank or piece of Marble cut out with a round Moulding above the Mantle-piece; but it is here chiefly taken for the *Concave* or Plate fixt in the Breaſt of ſome Chimneys.

Talk, a Kind of Mineral, white and tranſparent like Cryſtal; Iſinglaſs.

Talus or *Talut*, (*Fr.*) any thing that goes ſloping or ſhelving; as *the* Talus *of a Wall in Maſonry*, when its thickneſs is leſſen'd by Degrees, as it riſes in Height.

Tampin, See *Tourillon*.

Tangent, (of a Circle in *Geometry*) is a Right-line drawn without the Circle, perpendicular to ſome *Radius*; and ſo nam'd becauſe it touches the Circle but in one Point.

Tangent (of a *Parabola*, or other *Conick* Section, or Geometrical *Curve*) is a Right-Line drawn ſo as to cut the *Axis* produced or lengthen'd, and touch the Section in one Point, without cutting it.

A *Thermometer* or *Thermoſcope*, (*Gr.*) a Philoſophical Inſtrument, uſually made of Glaſs, fill'd with tinged

tinged Spirit of Wine, or some other proper Liquor; which by its rising and falling, serves to measure, or shew the several Degrees of Heat and Cold, of any particular Place, or of the same Place in different Seasons, and at different Times.

Tourillon, (*Fr.*) a round Iron-plate for a piece of Wood to turn upon, a Tampin.

Transpiration, (*Lat.*) a breathing thro', as of Vapours thro' the Pores of the Skin.

A *Traverse*, the Cross-piece of the Mantle-tree of a Chimney. See *Chambranle*.

To *Traverse*, to cross, or go thro' a Country or Place.

A *Triangle*, (in *Geometry*) a Figure that has three Sides, and as many Angles, and it is either Plain or Spherical; the former is that whose Sides are Right-Lines, and the latter has Curves or crooked Lines for its Sides, as the Arches of Circles, *&c.*

Trunked, (*Fr.*) curtailed, or cut off on the top, or at the end.

A *Tube*, (*Lat.*) a Conduit-pipe, any long Pipe thro' which Water or any other Liquor is convey'd.

Tunnel, See *Funnel*.

A *Vacuum* (*Lat.* in *Philosophy*) a Space void of all Body.

Velocity, Swiftness, Nimbleness.

Vertex, (*Lat.*) the Top of any Thing. In *Geometry*, the Point of any Angle is termed its *Vertex*; and that Point of the Curve or crooked Line of a *Conick Section*, where the *Axis* cuts it, goes by the Name of the *Vertex of that Section*. The *Vertex* of a Cone, Pyramid, *&c.* is the Point of the upper Extremity, or end of the *Axis*, or the top of the Figure.

Vertical, belonging to the *Vertex*, or that is directly over one's Head, or Perpendicular, and so contradistinguish'd from *Horizontal*, *i. e.* that lies parallel with the *Horizon*, or even with the Ground.

To *Void*, to go out or depart from, to discharge by Stool or Vomit: In a *Mathematical Sense*, to cut out the Metal or Stuff on which any Figure has been trac'd or drawn; as *to void a Triangle*, &c,

A *Volume* (*Lat.*) a large Book, a Book of a reasonable Size to Bind by it self: A *Volume of Air*, is a certain Compass or Extent of it.

W.

The *Wings* (of a *Chimney*) the Sides of the Funnel above the Jambs.

THE

THE QUALITIES and OPERATION OF FIRE, Explain'd by Mechanical Principles.

The First TREATISE.

Of certain New-invented Chimneys, that give more Heat than the Ordinary Ones do, and are not liable to ſmoak.

BOOK I.

Of the Diſpoſitions and Properties of theſe Chimneys to encreaſe Heat.

IT ſeems that thoſe who have hitherto built or caus'd Chimneys to be erected, have only taken care to contrive in the Chambers certain Places, where Wood may be burnt, without making a due Reflection, that the Wood in burning ought to warm thoſe Chambers and the Perſons who are in them;

them: At leaſt it is certain, that but a very little Heat is felt of the Fire made in the ordinary Chimneys; and that they might be ordered ſo as to ſend forth a great deal more, only by changing the Diſpoſition of their Jambs and Wings, tho' that Alteration is but one of the means which we ſhall hereafter lay down in this Book, in order to encreaſe the Heat that is drawn from Fire made in Chimneys. *Hottes.*

PART. I.

Of Fire, and of the Interiour Diſpoſitions of the Fore-part of Chimneys to encreaſe Heat.

BEFORE we come to ſhew what Diſpoſitions of Chimneys are moſt capable of contributing to augment the Heat of Fire made therein; it is expedient to enquire upon what Account and after what manner that Fire warms the Chambers and the Perſons who are in them.

CHAP. I.

Of Fire, of its Rays of Heat, and of the various Ways whereby it affords warmth.

AS luminous Bodies ſpread round about many Rays of Light; ſo Fire likewiſe diſperſes and puſhes forth on all ſides numerous Rays of Heat; ſince on what ſide ſoever we come near it, the Impreſſion thereof is felt, and even ſometimes to the quick.

We underſtand by Rays of Heat, as well the Particles of Wood that ſeparate themſelves, when it is burning, as thoſe of the Matter with which the Fire is encompaſs'd, and which it puſhes forth round about.

Theſe Rays are either direct, when they proceed directly and immediately from the Fire; or reflected, when they are turn'd upon their meeting with ſome other Body, which ſends them back again; and in being thus reflected back, they muſt follow the ſame Laws with the Rays of Light; that is to ſay, their Angle of Incidence, is equal to their Angle of Reflection.

If we except from theſe Rays thoſe that fly up perpendicularly, all the others either direct or reflected muſt deſcribe a Line, which perhaps it is impoſſible, and cer-

certainly needleſs to determine. For as well thoſe, the Direction of which is forthwith parallel to the *Horizon*, as thoſe that have an inclined one, they muſt all have a perpendicular Motion; ſince Experience makes it appear, that all hot minute Bodies have a tendency to riſe upward. Thus in the Water and in the Air, the hotteſt Particles are always above, to which pitch they get proportionably as they grow hot.

See Chap. 1. of the 2d Part.

The Motion then of a Ray of Heat, when its Direction is not perpendicular, is compoſed of a perpendicular Motion, and of one that is parallel or inclined to the *Horizon*; and this Ray conſequently deſcribes a mean Line between the Perpendicular and the Horizontal, or a Line inclined to the Horizon, and always has a tendency to fly upwards, ſo that the more remote it is from the Origine, the higher it has riſen. All this ſhall have its application in the following Chapters.

Fire may warm a Chamber, and thoſe that are in it, after ſeveral manners.

1ſt, By its direct Rays.

2d, By its reflected Rays.

3d, By a kind of *Tranſpiration*, in conveying its Heat thro' ſome ſolid Body, with which it is ſurrounded; after this manner the Fire of a Stove communicates its Heat.

By the *Heat* of Fire, or of any other Body whatſoever, we underſtand a certain Motion of its Particles, which when it comes to our Bodies, cauſes us, or rather gives us occaſion, to have a Senſation of Heat, and ſometimes of Pain, when it is too violent.

In the ordinary Chimneys, Fire does not heat by Tranſpiration, it alſo ſends forth but very few direct Rays, and turns back a ſtill leſs number of reflected ones; as it will appear in the following Chapter. But in thoſe Chimneys of which we give the conſtruction in this Treatiſe, the Fire ſends forth many more Rays, and with greater force, and heats much more by Tranſpiration than by its direct and reflected Rays.

CHAP. II.

That the Diſpoſitions of parallel Jambs and inclined Wings of the ordinary Chimneys, are not proper for reflecting Heat into the Chambers.

Fig. 1. SUppoſe a Fire *Ff* made in an ordinary Chimney *A B b a*, the Jambs of which *AB*, *ab* are parallel; the Ray of Heat *f G* will be reflected back in *M*, the Ray *f H* upon it ſelf in *f*, the Ray *f I* in *N*, and the Ray *f L* in *P*: And ſince this Ray *f L* going from *f* to *L* continually, flies upward, as well

after its having been reflected back in paſſing from *L* to *P*, it enters the Chimney before it comes to *P*; and in what place ſoever it afterwards ſtrikes on the Wing *OR*, which is inclined to the Horizon, it is reflected back above in the Chimney, always ſuppoſing the Angle of Incidence equal to the Angle of Reflection; ſo that the ſaid Ray does not paſs into the Chamber at all. *Fig.* 3.

Upon examining in like manner all the Rays that fall between *H* and *a*, we ſhall find that none can be reflected back into the Room, but thoſe which fall on the extremity of the Jamb at *a*: But foraſmuch as in arriving there, they have almoſt loſt their whole force, which diminiſhes in proportion, as they remove from the Fire, they can ſcarce be reflected back, or cauſe the leaſt heat: And farther, Jambs made of Plaiſter have but little diſpoſition for reflecting back the Rays of Heat, as being very ſoft and porous. *Fig* 1.

As for the Ray *f H*, which is reflected upon it ſelf at *F*; it cannot by any means enter the Chamber.

The Ray *f G* reflected back in *M*, whatſoever other Reflection it may afterwards undergo, apparently gets up into the Chimney, and does not go out of it but thro' the top of the Funnel, no more than all thoſe that ſtrike, and are reflected back between *H* and *a b*

The ſame thing befalls the Rays which go from *F* upon *AB*; and from the latter, an eſtimate may be taken of thoſe, which from all the other Parts of the Hearth, where there is any Fire, come to fall on the two Jambs *A B*, *a b*.

All the other Rays, as *FAB*, which ſet out from the Fire *F*, and in departing from it, go to the Back of the Chimney; ſince they are there very near their Origine, by reaſon of their being hitherto but little raiſed up or inclined to the Horizon, before they come to touch it, they make a very ſmall Angle in ſtriking it; ſo that after having been reflected back, they enter the Funnel of the Chimney; or if ſome of them, as *FGMN* happen to ſtrike the Wing *OR*, a ſecond Reflection, throws them again into the Chimney, where they fly up and are loſt. *Fig.* 3.

Scarce any therefore but the direct Rays which go from before the Fire, can get into the Chamber and warm it; they muſt alſo ſet out in a Direction parallel, or near upon ſo, to the Horizon: For thoſe, the Direction of which is ſenſibly inclin'd to it, ſince they fly upward proportionably as they depart from their Origine, they almoſt all enter the Wing of the Chimney, before they come to the *Chambranle*, as *F I*, and in ſtriking on the Wing *OR*, which is inclined, they are alſo reflected back into the Chimney, and become uſeleſs.

As

As for the Rays whoſe Direction is perpendicular, they all paſs into the Tunnel of the Chimney, ſo that none of them can go out but at the top.

Thus we perceive that of the great number of Rays of Heat which go from the Fire, only a very ſmall part conſtantly get into the Chambers, in the ordinary Situation of the Jambs and *Wings of Chimneys; and by conſequence, that thoſe Diſpoſitions are not convenient, in order to give the Heat which is ſought for by cauſing Fire to be kindled in them. Upon the whole, a Judgment may be made of the Effects of the other more ancient Chimneys, by what has been but now ſaid of that of the Modern ones.

*Hatter.

It is true, that there are ſome Chimneys, the Corners of which are rounded, others whoſe Jambs are lin'd with Plates of Iron or Copper, and ſeveral (after the Breaſts have been taken away, and *Concaves* ſet in their room) whoſe Wings are no longer ſo large, nor ſo upright as they were before; and that all this contributes to give a little more Heat than was drawn at firſt from thoſe Chimneys: But a great deal more is ſtill requiſite for their ſending forth as much Heat, as they would actually do, if a proper Diſpoſition were given to the Jambs and Wings, different from that which they now have; as may be ſeen in the following Chapter.

*Tablettes.

CHAP. III.

That Jambs form'd with Parabolical Lines and an Horizontal Situation of the lower part of the Concave, are moſt proper for reflecting Heat into the Chambers.

GEometricians are ſenſible that all *Radius*'s which ſet out from the *Focus* of a *Parabola*, and fall upon its Sides, are reflected back parallel to its *Axis*.

If therefore you take on the bottom of a Chimney-Hearth *A B b a* a length *C c* equal to that of the Wood deſign'd to be burnt, for example of half a Log or Billet, which at *Paris* is 22 Inches; from the Points *C c* let fall the Perpendicular *C D*, *c d*, which may be the *Axes* of two *Semi-Parabola*'s, whereof *C c* are the *Vertices*, and *A a* (the Diſtance between which is the Breadth of the Chimney) each of them one of their Points: That done, you are to line with Iron or Copper-plates the two Parabolical Sides *A C*, *a c* of the Chimney, and make the lower part *o i m* of the Concave parallel to the Horizon, and as large as it can be, only leaving 10 or 12 Inches for the Aperture of the Chimney-Funnel.

Fig. 2.

Fig. 3.

I affirm then, that this Chimney will not only give and reflect beyond compariſon more Heat than the ordinary ones, but, will even reflect as much as is poſſible,

ble, and more than any other Diſpoſition.

For, if we ſuppoſe *F f* the *Focus's* of two Semi-Parabola's, and the Wood, (which is of the ſame length with the Diſtance *F f*) burning on the Hearth; all the Rays of Heat proceeding from thoſe *Focus's*, as *f g f h f i f l*, which in the former Figure or Diſpoſition of the Chimney, do not enter the Chamber, and are entirely uſeleſs, will be reflected back parallel to the *Axis c d*, in *m*, *o*, *n*, *p*, and by conſequence paſs into the ſaid Room: Thoſe Rays, which after having been reflected on the Jambs are found on the top of the *Traverſe* of the *Chambranle* at 12, 15, or 20 Inches from the Ground-plot of the Chimney, and would be reflected back on the inſide, by reaſon of the Inclination of the Wing *O R* in the firſt Conſtruction; will be reflected back into the Chamber, by ſtriking upon *o i m*, which is parallel to the Horizon. *Fig.* 2. *Fig.* 3.

The Rays *F G M*, &c. that ſtrike on the Ground-plot of the Chimney, in regard that their Angle of Reflection is but little ſenſible, will come again to ſtrike the lower Horizontal part of the Concave *m i o*, and conſequently be reflected back into the Chamber at *n*. The ſame thing, with greater Strength of Reaſon, will befall the Rays that fly up almoſt perpendicularly, and have the greateſt Force.

And farther, the Sides of the Chimney in this Diſpoſition, being a great deal nearer the Fire, (tho' it has the ſame Aperture as in the former Figure) will grow hot ſooner, and to a higher degree, and conſequently reflect a greater number of Rays, and with more force. *Fig.* 2.

The lower part of the Concave, on which the reflected Rays *F G m* do not only ſtrike, but even a conſiderable part of the direct ones, as *F i l*, which depart a little from the Perpendicular, and have a mighty Strength, muſt alſo grow hot very ſpeedily, and by conſequence reflect with a great deal of Force, all the Rays that ſtrike there, either directly as *F i l*, or after they have been already reflected back, as *F G m n*. *Fig.* 3. *Fig.* 3.

It has been ſuppoſed, that the Rays which fell on the Parabolical Sides of the Chimney *A C*, *a c* ſet out from the *Focus's F f* of the *Semi-Parabola's*, and ſome go from above and from below thoſe *Focus's*, and from the whole ſpace *F f* that lies between them, accordingly as the Fire is diſpoſed, and as there is more or leſs of it: However, it only follows from thence, that all thoſe other Rays, as *E H I* and the like, are not reflected back parallel to the Axis *C D*; but they continually do it in ſuch manner, that they all paſs very near into the Chamber, which *Fig.* 2.

which is the Buſineſs here in hand, as to the uſe and effect required.

It may perhaps be imagin'd at firſt ſight, That the Horizontal and advanced Diſpoſition *m i o*, which is given to the lower part of the *Concave may occaſion ſmoaking; but we ſhall ſhew, in treating of Smoak, That this Diſpoſition as well as that which is given to the Jambs, both contribute to prevent that inconveniency, and that the Draughts of the ordinary Chimneys are one of the Cauſes of Smoak.

Fig. 3. *Tablette. *Hottes.*

CHAP. IV.

Of the Vent-hole, upon what *Soufflet. *Account it ſends forth Blaſts, and how it ſerves to encreaſe the Heat, and make it reflect.*

THERE is alſo another means to cauſe a great deal of Heat to reflect into the Chamber, which may be made uſe of in the ordinary Chimneys, but to better Advantage in theſe we are now deſcribing.

In the middle of the Hearth, and about 10 or 12 Inches from the Ground Plate, it is expedient to make a ſmall *Trap-door Z, which may be eaſily open'd and ſhut, and underneath a little Cavity that has Communication with the outward Air. When this Door is ſomewhat rais'd up, the Air will enter from without, thro' the exteriour Aperture, and iſſue forth thro' the Outlet or Paſſage *x* made for it in the Vent-hole: For the Air will be continually more preſs'd abroad than in the Chamber, whether the Wind blows or the Weather be calm, when there is any Fire on the Hearth; by reaſon that the heat of the Fire rarifying the Air, and cauſing part of it to go out thro' the Chimney with the Smoak, there will be a kind of *Vacuum*, or at leaſt an Air that will leſs preſs before upon that which is ready to go out of the Vent-hole, than it is preſs'd behind by the exteriour Air; and ſo cauſe it to paſs on the Hearth, and in entring to raiſe a Wind more or leſs ſtrong, accordingly as the outward Air is more or leſs agitated, or more or leſs condenſed, and as that of the Room is more or leſs rarify'd.

Fig. 2. 3. *and* 6. *Trape. *Fig.* 3.

Now this Wind will not only ſerve to kindle the Fire, and make it continually blaze at pleaſure, be the Wood ever ſo green; but it will alſo puſh with a great deal of force the Flame and Rays of Heat, as *F G m n F S T*, to occaſion their reflecting into the Chamber, after one or two Reflections, when the Fire is lighted. *Fig.* 3.

Altho' the conveniency is very great to be able thus to kindle

and

and make ones Fire blaze, and in a very ſhort time, to encreaſe its Heat, as alſo that which it produces in the Rooms, by means of this kind of Vent-hole; nevertheleſs theſe are not the only uſes to which it is appropriated, nor the only Advantages that we ſhall gain thereby; as will appear in the Fifth Chapter of the firſt Part of the Second Book.

The Invention of this Vent-hole is not new; I apply'd it for the firſt time above twenty Years ago, after having ſeen the uſe of it elſewhere, to kindle Fire, which was the only Convenience then attributed thereto.

CHAP. V.

Means to deſcribe the Parabolical Sides of Chimneys, either by ſeveral Points, or by a continual Motion.

THERE are different manners of deſcribing *Parabola's*, either by drawing ſeveral Points near one to another, or by a continu'd Motion; we ſhall only here lay down ſome of the moſt facil Methods.

The extent or ſize *AB b a* of a Chimney being determined, for Example, of 3 or 4 Foot in Breadth, and of 18 or 20 Inches in Depth; you are to take out of the middle of the Ground-Plot of that Chimney *C c*, the length of the Wood deſign'd to be burnt, for inſtance, 22 Inches: Then let fall the Perpendiculars *C D c d*, each equal to the depth of the Chimney, for the *Axes* of the *Parabola's* you would have deſcrib'd, of which *C c* will be the Poles, and *A a* each one of their Points; thus you'll ever have known, the *Axis* of the *Parabola*, its *Vertex*, and one of its points. The whole then is reduc'd to ſolve the enſuing Problem. *Fig.* 2.

PROBLEM.

A Point of a Parabola *and its* Axis *being given, to deſcribe that* Parabola.

The RESOLUTIONS.

If from the Point given, a Perpendicular be let fall upon the *Axis*, it will be an *Ordinate*, and the part of the *Axis* which it cuts, an *Abſciſſa*, and the third Proportional to the *Abſciſſa* and the *Ordinate*, will be the *Parameter*; the fourth part of which drawn upon the *Axis* from its *Vertex*, will give the *Focus*.

So then let *a* be the given Point of the *Parabola* deſign'd to be deſcribed, and *c d* its *Axis*; now if *a d* be drawn perpendicular upon *c d*, and *c b* equal and parallel to *d u*, and *b o* perpendicular on the Line *d b*; the Line *c o* will be the *Parameter*. *Fig.* 4.

For

For admit $cd = x$; da, or $cb = y$; and $cq = p$; the result will always be $x . y :: y . p$, or $px = yy$; so then taking $cf = \frac{1}{4} p$, f will be the *Focus* of the *Parabola*, which may be afterwards easily described by one of the following Methods.

A Method to describe the Parabola, *by finding out several of its Points.*

Thro' the extremity of the *Parameter* o describe several Semicircles obd, ohg, ohg, less one than the other, and the Parts ch, ch of the Line cb which determine those Semi-circles, being raised perpendicularly upon the Points g, g, where the Semicircles, cut the *Axis*, will mark the Points h, h, h, of the *Parabola*: Since the Square yy of every one of those Lines will always be equal to px the Rectangle made of the *Parameter* and part of the *Axis* comprehended between its *Vertex*, and every one of those Lines. This is the usual method of describing the *Parabola*.

Another manner of describing the Parabola, *by finding out several of its Points.*

If we take CQ equal to CF or a fourth part of the *Parameter*, and from the *Vertex* C of the *Axis* CD, draw all along the Perpendiculars GH, GH: Then proceed to take the distance QG, QG, from Q to each of those Perpendiculars on the *Axis*, for the *Radius* of a Circle, the *Focus* of which F is described as a Center of the Portions that cut those Perpendiculars in H, H; they'll determine there, as many Points of the *Parabola*, which is to be drawn in joyning all by a Line $CHHHA$. *Fig.* 4.

For suppose QC or $CF = \frac{1}{4} p : CG = x : FG = x - \frac{1}{4} p : GH = y$; thence will arise FH^2 or $QG^2 = yy + xx - \frac{1}{2} px + \frac{1}{16} pp$: We shall also find $QG^2 = xx + \frac{1}{2} px + \frac{1}{16} pp$, and consequently $px = yy$ (by taking away from both Parts the Square $xx - \frac{1}{2} px + \frac{1}{16} pp$) which is the Equation of the *Parabola*.

Instead of drawing several Perpendiculars GH, GH, you may make use of an Instrument call'd a *Mason's Square* NGL, which may be set so as to slide along the *Axis*.

Means to describe the Parabola, *by a continued Motion.*

Altho' it is a very easy matter to find out all the Points of a *Parabola* by the preceeding Method, more especially in applying the Square-Instrument; yet it may be more readily, and even more conveniently describ'd by a continued Movement, according to the following Directions.

1st, Let CQ be equal to CF, and $RQqr$ perpendicular upon FQ; let a Mason's Square LGN be brought *Fig.* 5.

to ſlide on *Q R*, and a *Rule F H V* turn'd on the Point, or the *Focus F*: Then let the two Parts *G H, F H* of the Square and of the Rule in croſſing each other be continually equal; their Points of Interſection *H, H*, will deſcribe the *Parabola*.

To know readily that the Parts *G H*, and *F H* of the Square and of the Rule are equal, it is requiſite to divide both before they are us'd.

2°, If at the extremity of one of the Sides of the Maſon's Square *l g n*, you faſten or tie the end *n* of a String *n h f*, equal to the Side *n h g*, and the other to the *Focus F*; let the Side *n g* and the String *n h f* be forthwith laid along the *Axis d f c*; let the other Side *l g* be brought to ſlide on *q r*, and let the String be continually kept ſtretch'd on the Side *n h g*: Then all the Points *h h* of the String that fly from the Square, will deſcribe the *Parabola*. This Method is ſtill more facil than the preceding; for there is no need of any Diviſion, or continual Menſuration, to know whether the Parts *G H, F H*, of the Square and of the Rule are equal; but due care muſt be taken that the String do not run out too far in length.

The Demonſtration of theſe two Problems is the ſame with that of the fore-going Method; and that's the reaſon why it is here ſubjoin'd to the former.

How eaſily ſoever the *Parabola* may be deſcrib'd by the Methods but now produc'd; yet we ſhall not take upon us to propoſe them to all Workmen, in order to be put in execution: In the third Book, which conſiſts of pure practical Matters, we ſhall lay down proper means for delineating the Sides of Chimneys, with a Draught made of a Right-Line, and of a Portion of a Circle, whoſe Center and *Radius* we ſhall determine, and which nevertheleſs comes near the *Parabola*, and has the ſame effect in Practice: For it is evident, that the Rays of Heat ſet out from different Places, which are continually chang'd in proportion as the Fire encreaſes or diminiſhes; and it may even happen, that no Ray of Heat goes from the Point where the real *Focus* of the *Parabola* is fixt, if the Fire be not in that part; ſo then it is not neceſſary in Practice, that the Draught of the Jambs be abſolutely Parabolical.

Altho' Parabolical Jambs are moſt proper for reflecting the Rays of Heat in greater Number, and with more force; nevertheleſs other Diſpoſitions may be given to thoſe Jambs, which would likewiſe very much augment the Heat of the Fire.

For Example, Suppoſe the Lines *C D c d* to be continually at the ſame diſtance from each other, and in the Situation that has been mark'd; if you take *C G* the double of *C F*, and *Fig.* 2.

and from the Point *G* and the Interval *G C*, deſcribe a portion of a Circle *C H*, and from the Point *A* draw thereupon a Tangent *A H*; all the Rays which fall from *F* upon *C H*, or at leaſt on the Part that is neareſt *C*, will be reflected parallel to *C D*, as if the Line *C H* were Parabolical, as it is demonſtrated in *Catoptricks*: And the other Rays which fall upon the Line *H A*, and on the portion *H C* neareſt to *H*, will be almoſt parallel to *C D*, and certainly paſs into the Chamber.

The Jambs *A H C*, *a h c* may alſo be made Elliptical, or in form of a quadrant of an *Ellipſis*, by taking each of the Lines *C D*, *c d* for half the great *Axis*, and *A D*, *a d* for half the leſſer. Then in carrying the Diſtance *C D* from *A* to *G*, that point will be one of the *Focus*'s of the *Ellipſis*, which may be afterwards eaſily deſcrib'd; and all the Rays of Heat that ſet out from the *Focus G*, will be reflected back upon *C D* in a Point, which would be the other *Focus* of the *Ellipſis*, as remote from the Center *D*, as the Point *G* is (as it is known to Geometricians) and conſequently they'll come to enter the Chamber. *Fig.* 2.

This Diſpoſition would alſo be very convenient for Kitchen-Chimneys; but it is only requiſite to take for the great *Axis* of the *Ellipſis* the length *C D*, which is the depth of the Chimney, or ſomewhat more, and for the half of the leſſer *Axis* two third Parts of *D A*, to the end that one of the *Focus*'s in which the Rays that go from the other are to meet together, may be near on the Line which joins the two Jambs before, for certain uſes that thoſe Chimneys are appropriated to.

And from the Point *C* is to be deſcribed a quadrant of the *Ellipſis C H*, on which you are to draw from the Point *A* a Tangent *A H*, and all the Rays that from the Point *F*, (which is one of the *Focus*'s) fall upon the quadrant of the *Ellipſis C H*, will be reflected in a Point *I*; and thoſe Rays that fall on the Tangent *A H*, after their Reflection, will come near that Point more or leſs; which we do not here explain any further, becauſe we are apt to believe that no great uſe can be made of it.

Thoſe Perſons, who to ſave Charges content themſelves with giving the Jambs of their Chimneys a Diſpoſition near upon Parabolical, and the lower part of the * Concave or Chimney-piece. *Fig.* 6. **Tablette.*

an Horizontal Situation, which may be done at a very ſmall Expence, and in all ſorts of Chimneys; by that means they'll render their Rooms a great deal warmer, without making more Fire therein; eſpecially if the conveniency of the Vent-hole be alſo apply'd: But they who think fit to add the

Diſpoſition of the back-part of the Chimney, which we are about to give an Account of, will thereby gain many other Advantages, as may be hereafter ſeen in the Second Part of this Book.

PART. II.

Of the Air, and of the Interiour Diſpoſitions of the back-part of the Chimneys, to heat the Chambers to ſuch a degree, and as ſpeedily as is required.

HOW great ſoever the quantity of Heat may be, which is drawn by the inward diſpoſition but now deſcrib'd of the fore-part of the Chimneys, and by the Horizontal Situation of the lower part of the Concave; it does not come near that which may be had by the interiour Diſpoſitions of the back-part of the Chimneys, that we are about to lay down, after having made ſome Remarks on certain inherent Qualities of the Air.

CHAP. I.

Of the Air, and of the Celerity with which it grows hot; that the hotter riſes above that which is leſs warm.

ONE of the Properties of the Air is to grow warm very quickly; I ſhall here only produce a ſingle but very ſenſible Experiment of it.

EXPERIMENT. I.

I took a bow'd Iron-Tube of from 3 to 4 Inches Diameter, like a *Siphon* or Crane, the bended part of which was laid on the Fire; the long Branch reach'd without thro' a Hole made proportionable thereto, and the ſhorter Leg was within my Chamber: A very cold North-Wind that enter'd thro' this Tube, iſſued out congeal'd before it came to the Fire; but it had not been there a moment, when the ſame Wind broke forth with impetuoſity and exceeding hot, and yet paſs'd with the ſame celerity thro' the Part which was over the Fire, as thro' the others; for the thickneſs of the Tube was every where equal: So that the Air grew warm in as little time as was requiſite for it to traverſe a ſpace of about a Foot, in paſſing it with a prodigious Velocity.

It is not poſſible to retain in a Chimney a Diſpoſition agreeable to the ſight, and ſuitable to the convenience of making a Fire therein, and at the ſame inſtant make it ſerve to give the Air that great degree of Heat in ſo ſhort a time: For the Fire which is capable of encompaſſing a Tube of near 4 Inches Diameter, and conſequently to heat on all ſides the Air which is enclos'd in the ſaid Tube, cannot in that manner ſurround and give warmth to the Air pent up about a Chimney: We can only by means of Fire therein, make hot the Air which plays behind the Ground-plot and ſides of the Chimney, ſuppoſing them hollow, and only warm it on the ſide where it touches them, at leaſt very ſenſibly; neither can it be to that degree as in the Tube juſt now mention'd.

So then the Air which would paſs very quick behind a Chimney, where it is only ſeparated from the Fire by a Plate of Iron or Copper, could never there acquire a great degree of Heat, eſpecially in Winter, if it did not paſs thro' ſeveral Places, where it might grow warm by little and little; and in ſeveral Moments that it continu'd before the Fire, or near ſome parts of the Chimney that the Fire warms, attain to a degree of Heat coming near that which it would acquire in a ſingle Moment, were it all ſurrounded with Fire. But what Courſe ſoever we cauſe the Air to have, we ſhall never give it the degree of Heat which it takes in paſſing thro' a Tube ſet over the Fire: However, we may give it what is ſufficient, and ſometimes more than is requiſite to warm a Chamber in a very ſhort time, be it ever ſo large, and the Weather ever ſo cold, which is all that is here requir'd.

The great Levity of the Air, and its Elaſticity, may well occaſion this Diſpoſition it has, of growing hot ſo ſpeedily, as it appears from the Experiment but now produc'd: For the leaſt Heat forthwith begins to augment the Elaſtick Force of the Particles of the Air, and ſo extend and ſeparate them more than they were before, as is evident from the ſpeedy Rarefaction of their whole Volume, which encreaſes in proportion as it grows hot. And the Particles of Fire, and of the Ethereal Matter ſpread about every where, fill up in an inſtant the Intervals left by the Particles of the Air in departing one from the other; and foraſmuch as this new Matter ſo introduc'd, is extremely agitated, it ſoon gives Motion in all reſpects to the Airy Particles, and by conſequence very quickly heats them.

Another Quality of the Air is, That the hotter riſes above that which is leſs warm: To be aſſured of this, and to know

near

near upon how much the Air of a Chamber where there is a Fire, is warmer on the top of it than at the bottom, and leſs at the bottom than in the middle, I made the following Experiments.

EXPERIMENT. II.

Having ſet two Air-Thermometers in my Chamber, one at the bottom and the other on the top near the Cieling, the latter, tho' more remote from the Fire than the former, roſe up a great deal higher and more ſpeedily: Then I chang'd the place of the Inſtruments, bringing down that above, and raiſing up that below; whereupon the Liquor immediately roſe in one, and fell in the other: I repeated this Practice ſeveral times, and the ſame thing always happen'd. Afterwards I plac'd both Thermometers near each other, at an equal diſtance from the Cieling above, and the Floor underneath: At that inſtant, the Liquor of that which was before at the bottom, roſe up, and ſubſided in that which was on the top; certain Marks, that the Air was warmer in the middle of the Room, than at the bottom, and ſtill more on the top than in the middle; and conſequently, that the hotter Air riſes above that which is leſs ſo: And that the difference between the Air on the top of a Chamber, where there is a Fire, and that which ranges at the bottom is very conſiderable; whence it may be alſo concluded, that thoſe Rooms the Cielings of which are loweſt, are the moſt apt to grow hot in due form, and that in Winter they ought to be preferr'd before the others.

EXPERIMENT. III.

If you are deſirous to have a more facil and ready Experiment, and ſuch as may be made at all times, to prove that the hotter Air riſes above that which is leſs warm; it is only requiſite to take a Gun-barrel or any other long Tube of Iron or Copper, open at both ends, laying it firſt Horizontally upon the Fire in the middle; and you'll perceive a little Heat to iſſue out of both its Extremities: But in elevating one, and depreſſing the other, the Air will go forth hot thro' the upper Aperture, with a ſufficient force to blow out the flame of a Wax-candle, and will heat the Tube from the part that lies over the Fire to the end, more and more, proportionably as it is raiſed higher.

If afterwards the Tube be turn'd, and the lower end raiſed upward, the hot Air will continually iſſue out thro' the end that is more elevated than the Fire, and will heat it, provided it be open. And the ſaid Air will not only forbear falling thro' the lower end, but alſo the whole

part

part of the Tube removed farther from the Fire which grew hot when 'twas raiſed, will cool as ſoon as it is laid underneath, even tho' it were a great deal ſhorter than the other; and although the lower Aperture be cloſe ſtopt, yet the Air will not ceaſe to go out hot thro' the upper, but with leſs Celerity.

If you are diſpoſed to bend the Tube in form of the handle of a Wheel, the Experiment may be more conveniently made, which ſenſibly proves as well as the preceeding, that the hotter Air always riſes above that which is leſs warm; as a piece of Wood gets above Water, becauſe the Air, in a like Volume, weighs ſo much the leſs as it is the hotter: For its parts are not only more agitated, but even more ſeparated one from another in proportion as it grows more hot; as appears from its Rarefaction, which is encreaſed by every degree of Heat.

CHAP. II.

Of the Interiour Diſpoſition of the back-part of the Chimneys; how the Air enters therein; how it grows hot, and ſucceſſively the whole Air of the Chamber; how the Air of another Room may likewiſe be warm'd there; of ſome other Advantages of this manner of Heating.

Fig. 6. 15, 16, 17, 18, *&c.*

SUppoſe the Circumference *AHC cha* of the inſide of a Chimney lin'd with a Plate of Copper or Iron, and behind that Plate a void ſpace of about 4 Inches in Depth divided and ſeparated by divers thin * Bands, or Bars of Iron, which form ſeveral Square Cavities, ſmall Cells, or Pipes ſet on the ſide one of another, the firſt of which has a Communication with the Second, the Second with the Third, *&c.* making all together a kind of curved or winding Canal, one extremity of which *D* is at the bottom, and the other *R* on the top of one of the Jambs of the Chimney, on the out-ſide; ſo that the Air may enter thro' the end of *D* below, and go out thro' that of *R* above.

* *Languettes.*

We may alſo ſuppoſe the under part of the Hearth empty, and in like manner cas'd with Iron or Copper-plates, and laſtly the undermoſt part of the * Concave hollow in form of a Pipe; and that all theſe Cavities as well of the back-ſide of the Chimney, and of the lower part of the Hearth, as of the undermoſt part of the Concave, form together a kind of winding Canal in many Places but now ſpecify'd.

* *Tablette.*

In

In the third Book we ſhall determine the Situations and Proportions of all thoſe Cavities, of their Entrance, Communications and Out-let, according to the Diſpoſitions and Dimenſions of the Chimneys and Chambers; and we ſhall ſhew how ſeveral different Conſtructions may be made of Chimneys, ſome of them more ſimple and eaſy to be put in execution than others; all which nevertheleſs have the Effects mention'd in the enſuing Chapters: But it may ſuffice at preſent, in order to apprehend in the Sequel of this Diſcourſe, the reaſons of thoſe Effects, to conceive on the back-part of the Chimney many Cavities that have a Communication one with another, and of which the Fire that burns on the Hearth is capable of heating ſome of the Surfaces.

Fig. 6. 17, 18, *&c.* This Diſpoſition then, and this courſe of the Air being ſuppoſed behind the Chimney, when a Fire is kindled, it will heat the Circumference of that Chimney, the lower part of the Hearth, the undermoſt and back-part of the Canal under the Concave (when there is one) and conſequently the Air that ranges in the Spaces which are enclos'd in thoſe Surfaces: And the cool Air that enters thro' the Aperture *D* below into thoſe Cavities, will begin to grow warm in the firſt; the Heat it has acquired will encreaſe in going thro' the ſecond, and ſtill more in paſſing into the third, *&c.* For as it proceeds, beſides that it takes at every inſtant a new degree of Heat, it paſſes into Places that are more heated; ſo that it muſt needs iſſue out very warm thro' the Aperture *R* on the top.

To make the Air of the Chamber enter after this manner thro' the lower Aperture *D*, and paſs into all the Cavities, what compaſs ſoever they may take, and iſſue forth thro' the Out-let *R* above; no other Artifice is requiſite but the Fire on the Hearth *Ff*; which heating the Air encloſed in thoſe Cavities, forthwith cauſes that which is in the latter, whoſe Aperture is on the top, to riſe and go forth, in order to paſs above the leſs warm Air, and ſo occaſions the following of all that is in the other Cavities, where, for that time, it undergoes a leſs preſſure before than behind.

And this Air in iſſuing forth thro' the Out-let *R* on the top, ſtill puſhes that of the Room, and makes it re-paſs thro' the Aperture *D* at the bottom, where it meets with the leaſt reſiſtance, and where the cooler Air is lodged, becauſe the hotter continually riſes upwards: So that as long as there is any Fire on the Hearth, the Air of the Chamber circulates without intermiſſion in the Cavities of the Chimney,

ney, and grows warmer and warmer during the Circulation; and ſince there may paſs, in a very ſhort ſpace even a greater quantity than the Room can hold, all the Air ſhut up therein may make many turns in a certain time, and get Heat by degrees.

It may be much better apprehended to what degree the Air muſt grow hot in thoſe Cavities, when the Reader has viewed in the third Book, the Conſtructions and Diſpoſitions of the different Routes of the Air, which in ſome will be quite ſurrounded with Heat, as it were a Tube in the midſt of the Fire. But it is already an eaſy matter to conceive that it may there contract a great deal of Heat in paſſing, if a Reflection be made upon the manner and Celerity with which (as has been ſhewn in the foregoing Chapter) the Air acquires warmth, and on the turnings and windings that we cauſe it to make.

For if but one Cavity were made under the Hearth, and behind the Back of the Chimney, as *M. Savot* in his Architecture tells us was done in the Chimney of the Library of the *Louvre* at *Paris*, the Air of the Chamber that paſſes therein, taking but a very ſhort courſe and without turning ſave only to riſe upward, will not ſenſibly grow warm, when it is cold, and ſtill much leſs, when this Air is brought from without; and yet it is always expedient, and ſometimes neceſſary to do ſo; as may be ſeen in the following Chapters.

If inſtead of cauſing the Air of the Chamber where the Chimney is, to circulate in thoſe Cavities, we ſhould bring in the Air of another Room adjoyning on the Side, behind, or even above, or underneath, by means of a Conduit fixt at the bottom of that ſecond Room, which might fall into the lower Aperture *D*; and if the Air were left to re-paſs there after having been heated by another Conduit reaching from the Cieling above to the Out-let *R*; we might alſo in a ſhort time cauſe to circulate for many turns, and give heat in the Cavities of the Chimney, to the whole Body of Air of the ſaid Second Room, that would be thus heated without making any Fire, which would prove a very great Conveniency upon ſeveral Occaſions. *Fig. 6. 17, 18, &c.*

And farther, the ſaid method of warming has this advantage, that in giving Heat to the whole Complement of Air in the Room, it warms all the Perſons who are in it, even at a conſiderable diſtance from the Fire; and that it keeps the Places always dry, becauſe the Air grows dry in paſſing thro' all thoſe Cavities, carrying away thither and leaving there, all the Moiſture it may take up in the Chamber, and from the Houſehold-Goods, as

it is circulating, and ſo preſerves them from the Dammage which is often occaſion'd by Thaws.

When the Air of a Chamber is very warm, it may be hinder'd from growing hotter, or at leaſt its Heat may be prevented from encreaſing ſo much, without quenching or diminiſhing the Fire; by ſtopping the Aperture *R*, from whence the warm Air comes in.

If the Aperture *D* at the bottom were only ſtopt, the Air would ſtill go out warm thro' that on the top, but in a leſs quantity; as we have obſerved in the preceding Chapter, that it iſſu'd forth thro' the upper end of the Tube, tho' the lower was ſtopt: Becauſe the hot Air in continually riſing above that which is leſs ſo; the ſame quantity of other Air ſubſides in its place; as Water deſcends in the room of a piece of Wood that aſcends therein.

CHAP. III.

That by the Diſpoſition but now laid down of the back-part of the Chimney, a Chamber may be heated, by cauſing Air from without Doors continually to paſs into it; be the Weather ever ſo cold; after what manner this Air enters the Room, and how it gives Heat thereto: Certain means to know in how long time the Air can warm the ſaid Room; how it may ſerve to augment or diminiſh the warmth without encreaſing or abating the Fire, &c.

Fig. 6. 17. 18. *&c.* IF exteriour Air be brought into Spaces in the back-part of the Chimney, by making a Communication from the Aperture *D* to the out-ſide; the Chamber will be warm'd ſtill more ſpeedily, and to better Advantage, than when the Air encloſed therein is only caus'd to paſs and diſtribute its heat: For for that time, the Air which goes out of the Cavities, after having circulated and grown hot in them, does not warm that of the Room, which is cold, but by mixing together with it, and by communicating ſome of its Heat thereto. And foraſmuch as the quantity of warm Air which iſſues out at every inſtant, is very little in compariſon of that which fills the whole Room; a conſiderable time muſt be taken up before all the Air in it can be ſenſibly heated, eſpecially when the Weather is extreme cold, and the Place large; ſince that Air does not paſs very quick.

The ſame thing does not happen, when the Air is taken from without Doors: For beſides that a much greater quantity of it for that inſtant goes forth at the ſame time thro' the Aperture *R* or *r*, becauſe it paſſes quicker, being continually more preſs'd without than in the Chamber, (as has been

been already explained in the fourth Chapter of the firſt Part:) This Exteriour Air does not only warm that of the Room, and the Perſons in it, by communicating ſome of its Heat, but even by driving out all the cold Air that is therein, and cauſing it to be ſucceeded by hot, after the following manner.

Chap. I. The warmeſt Air continually riſes above that which is cooler: So then the Exteriour Air that enters the Chamber, after it has paſs'd thro' the Cavities of the Chimney, and attain'd to a greater degree of Heat than that which is there (when the Fire has been kindled but a little while) it riſes up to the top of the Cieling: And foraſmuch as it cannot take place, till it has driven away, and at the ſame time caus'd as much Air of the Room to go out; and ſince the latter cannot depart but thro' the Chimney, the only Out-let it meets with which is below; Air is continually iſſuing out from underneath, proportionably to what enters and riſes upward.

Now the Air from below is alſo the cooler, in regard that the hotter riſes above that which is leſs ſo: The coldeſt Air therefore, and that which was in the Chamber before the kindling of the Fire, goes out at the ſame time that the warmer comes in: And ſince in a little while, there may enter more than the Room can hold; at the ſame time it is to be renewed, the cold Air muſt be gone, and be ſucceeded by warm. If any Perſons are deſirous to know near upon, in what ſpace of time this Alteration can be made, they may have recourſe to the following Method.

By placing for Example a Paper *P* hanged upon a Thread faſten'd to the Cieling, over againſt the Aperture *R*, thro' which the warm Air enters the Room; this Air in its Paſſage will beat back the Paper, if it be of the length of two Foot, in the quarter of a Second of Time. If the ſaid Aperture be half a Foot ſquare, above two ſquare Foot will enter in a Second; for ſince the Air is capable of ſpreading it ſelf on all ſides in going out of the Aperture *R*, it makes the leſs preſſure upon the Paper, in Proportion as it departs from thence: So that in a Second, above two Foot ſquare of Air being enter'd; in a Minute about 125 Foot will be likewiſe enter'd in paſſing with the Celerity that we have ſuppos'd; and it is always greater, when the Wind blows ever ſo little. *Fig.* 6. 17.

Admit now the ſpace of the Chamber in which all the Air is contain'd to conſiſt of 2000 ſquare Foot; in 15 Minutes or a quarter of an Hour, there will be enter'd as much Air as it can hold, and two or three times more, if it enter quicker, or if the Aperture *R* be larger than the ſuppoſed Dimenſion.

It muſt not however be concluded from thence, That all the cold Air which was in the Room is abſolutely gone out; for it continually mingles together with the hot which comes in with the cooler that is therein: But we are at leaſt certain of it, That the greater part of the cold Air is iſſued forth, that the Air by this means is already very much alter'd, and extremely heated in that quarter of an Hour; and that in half an Hour, it can and muſt needs be entirely ſo qualify'd.

Not that the Air which is left after that time, muſt be as hot as that which enters: For accordingly as it riſes, it paſſes thro' an Air that is colder than it ſelf, and by conſequence cools, in giving a little Heat to that thro' which it goes: However, it retains part of its Heat, of which it has more and loſes leſs in the ſecond Moment than in the firſt, and in the third than in the ſecond; becauſe the Cavities of the Chimney, where the Air takes its Heat, as well as the Air of the Room, thro' which it afterwards paſſes, grow hot more and more: So that in leſs than half an Hour or a quarter of an Hour, the Chamber-Air is ſufficiently hot, to give Heat equally every where to Perſons who are cold, and to preſerve it in thoſe that are warm.

And not only this Air in thus ent'ring, expels the cold Air out of the Chamber, but even hinders any from getting in, at leaſt ſo much as it does thro' Doors and Windows that do not ſhut cloſe, by reaſon that in keeping the Room continually full, the Air from without meets with more reſiſtance there, and the little which comes in, having leſs force, than it would otherwiſe have, and mixing together in ent'ring with the warm Air it finds, it grows hot e're it comes to the People in the Room, who conſequently never perceive any inconveniency, provided they be not too near thoſe Doors and Windows all the Out-lets or Crevices of which may be abſolutely ſtopt up, without ſtanding in fear, (as in other places) of being annoy'd with Smoak; as we ſhall ſhew in the following Book.

And indeed, by this Means no ſmall Miſchief is avoided, ſo as to be able to ſecure one's ſelf from thoſe Winds that enter thro' Places not cloſe ſhut up, and which may be called * *Chink-Winds*; ſince it is but too well known by Experience, how much the grievous Effects of them are to be dreaded.

* *Vents Coulis.*

This Air, which comes thus continually from without into a Chamber, heating it more and more, may do it even to a degree that would be troubleſome. Now it is an eaſy matter to prevent ſuch an Inconvenience, in caſe it be perceiv'd, by ſtopping the A-

perture

perture * *R* thro' which the hot Air comes in; ſo that without diminiſhing the Fire, the Heat would abate or ceaſe from augmenting: But we ſhould no longer receive freſh Air, which is the greateſt Advantage of this Diſpoſition of a Chimney, as will appear in the Sequel.

* *Fig.* 6. 17. 18.

It is therefore more expedient to leave a Communication with the cool Air that comes directly from without, near the Place *R* where it iſſues forth hot; to the end we may be always able to let in Exteriour Air, ſometimes warm, ſometimes cool, and when it is thought fit, temperate, or mixt with hot and cold, to any Degree whatſoever, at Pleaſure; by opening either or only ſuch part as ſhall be judg'd proper of the two Conduits, thro' which the cold and hot Air may paſs, and ſo augment and diminiſh the heat of the Room without encreaſing or leſſening the Fire. In the third Book, we ſhall lay down the means of doing it after the moſt convenient manner.

Thoſe Perſons who would have the hot Air that enters the Chamber, come to ſtrike with all its force upon their Feet or Hands, ſo as to heat them in a ſhort time, and keep them always warm, at any diſtance from the Fire; may do it by applying to the Aperture *R* one of the ends of a Tube of Tin, or only of Paſte-board, and the other end near the Part they would have ſo heated or kept warm.

Fig. 6, 17.

And if they are diſpoſed to have this Tube convey'd into a Bed, the Air that goes out of it, and diffuſes it ſelf thro' the whole Bed between the Sheets, will warm it as much as is requir'd: And in regard that this Tube takes up but little room, nothing can hinder it from being laid in the Bed, even when one lies in it, nor from cauſing the hot Air to iſſue out and ſtrike upon any Place or Part at pleaſure, which would give Heat thereto very gently, and keep it continually warm.

This Practice may be very Convenient and of ſingular Advantage, eſpecially for certain ſick Perſons, whoſe Attendants are oblig'd to warm their Linnen from time to time without intermiſſion. Others alſo who can get no warmth during the Night, in very cold Weather, may make uſe of this moſt facil means, in order to give it themſelves, and preſerve ſuch a Degree of Heat as is neceſſary for them.

The Air that is drawn out of the Room may likewiſe ſerve for theſe Purpoſes; but the Effect would neither be ſo conſiderable nor ſo ſpeedy, as may be eaſily apprehended from what has been already ſaid.

Laſtly, The ſame Air in ent'ring continually hot and dry, preſerves the Houſehold-Goods, and keeps them from Moiſture, much bet-

ter

ter than the Air of the Room does in its Circulation.

CHAP. IV.

That this Manner of warming a Chamber by means of an Air that is always freſh is very advantageous to ſecure us from many Inconveniences, eſpecially Ladies; as alſo neceſſary for ſick Perſons, and thoſe that attend or come to viſit them.

THE ſpeedy, gentle and agreeable Warmth felt in heating one's Chamber by the Air taken from without, is neither the only nor the moſt conſiderable Advantage gain'd by this Method of giving Heat; it is alſo of ſingular uſe to ſecure us from many Inconveniences occaſioned by exceſſive Cold and too violent a Fire: For ſince no Man is oblig'd to have the latter ſo great, nor to be ſo near it in order to warm himſelf; thoſe more ſolid Particles of the Wood do not enter the Room, or at leaſt we are not ſenſible of them; which by their bigneſs, ſtiffneſs and quick Motion, burn, dry up, and conſume the Lungs, and ruin the Eyes, as appears by the Pain felt in that Part, and by the redneſs they often occaſion therein. Thoſe Particles have the ſame effect upon the delicate Skin of Ladies, tho' leſs ſenſibly than on the Eyelids, and by putting the Fibers out of order, alter and quite ſpoil their Complexion; all grievous Annoyances, which we are no longer expos'd to by the means of theſe New-invented Chimneys.

But if this Manner of heating a Chamber is ſo beneficial to thoſe who are in good Health, we may well affirm it to be neceſſary for ſick Perſons and ſuch as have the management of, or come to viſit them:

For the noiſome Breath of the Patients, the corrupt Humours that come from them by Tranſpiration, and the malignant Particles which exhale from the Medicines they take, caſt up, or void by Stool, inceſſantly mingling together with an Air which ever continues the ſame (becauſe none durſt open any Place to let in freſh, when the Weather is ever ſo little ſharp) render it more and more Infectious. Thus a ſick Perſon takes in an Air more depraved and more peſtilential than that which he breaths out, and thoſe who viſit him imbibe the ſame. Now can it be doubted but that this often occaſions the Death of the Infirm and the Sickneſs of ſuch as look to, or give them frequent Viſits?

But if by means of theſe Chimneys, freſh warm Air be continually let in, to a degree of Heat that the Patient can well endure; this freſh Air will drive away that of the Room without intermiſſion, and cauſe him to breath a more pure and healthful one, together

gether with all thoſe Perſons who are in his Chamber; and will ſecure them from the Annoyances and Miſchiefs that an Air impregnated with poiſonous Particles would certainly bring upon them.

The ſame Heat that may be thus introduc'd and maintain'd in the Chamber of a ſick Perſon, to what Degree you pleaſe, makes it no longer neceſſary to keep him cover'd ſo cloſe and choak'd up with Blankets, *&c.* as is uſually done, even to an Oppreſſion and as it were Suffocation; and he himſelf during the ſharp Seaſon is not liable to cool and catch cold in ſtirring.

CHAP. V.

That the Exteriour Air, which is after this manner let into a Room cannot occaſion any Inconveniency; and that on the contrary it tends very much to the preſerving of Health.

SOme perhaps may be apprehenſive that warm Air is not ſo proper for the preſervation of Health. Altho' this may be true with reſpect to Air that is very hot and continually pent up, and which only derives its greateſt Heat from extragenous Bodies mixt together with it; as burning Particles of Wood or Coal, which being contrary to our Temperament, render that Air noxious; as is experienced in Places where Stoves are fixt, and even in thoſe where there are Chimneys in which too great a Fire is made.

The ſame Thing does not befal temperate Air that is continually changing, ſuch as that which we draw from without-doors by our Machine; this indeed is the only proper Air in Winter, at leaſt the moſt convenient for preſerving Health. Experience with ever ſo little Application will ſufficiently ſhew the truth of the Aſſertion, and it is alſo demonſtrable by Reaſon: For beſides that this manner of heating and tempering the Air, in cauſing it to paſs thro' the Cavities of the Chimneys, purifies and renders it more healthful; It is certain, cold Air deprives us of that Heat, which nevertheleſs, we abſolutely ſtand in need of in order to live; and that its minute Parts, or at leaſt the Aqueous Particles with which it is mixt, being for that time many joyn'd together, and but little Flexible, if we have ſufficient Heat to give them a great deal of Motion; they may thereby diſorder and tear the Fibers of our Body, more eſpecially thoſe of the Lungs, where the Air inceſſantly enters, and ſo make us obnoxious to divers Diſeaſes.

We often ſee in Flowers the ſad effect of the agitation of thoſe Particles which Cold has united and made inflexible, when after a ſmall Froſt, the Sun darts upon and violently ſtirs them, before they are as it were diſſolv'd; and

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what falls out in our own Bodies, when being very cold, we come too near the Fire, is yet a more ſenſible Proof of it: For the great Heat giving too much Motion to the Minute Parts that are frozen, they forcibly hit againſt the Fibres of our Muſcles, put them out of their natural Order, and by that force cauſe the ſharp Pains we feel upon ſuch Occaſions; which would not happen, if we warm'd by little and little the Parts that were ſo ſmartly ſeiz'd with Cold:

For the frozen Particles diſſolving by degrees, and of ſtiff becoming flexible, and like thoſe of a temperate Air, after having acquir'd that great Motion, they then give way upon the meeting our fineſt Fibers, and ſo do not put them out of Order nor tear them; nor raiſe in us any ſenſation of Pain; as neither would they have done it, if they had always been in that ſtate of Pliantneſs, and the Cold had not acted upon them.

To conclude, I am apt to believe, that theſe Reaſons and Experiments are ſufficient to make it appear, that the Air being always mingled with Moiſture and Vapours, which the Cold has ſuddenly congealed; we cannot be too cautious in avoiding cold Air, nor continue too long in a gentle and temperate one, which only is proper for preſerving our Health, and very far from impairing it.

CHAP. VI.

That in keeping continually very warm in a Chamber, as may be done by means of a Chimney of the like Nature, we are leſs liable to get a Cold when we go abroad.

SOME Perſons who have made tryal of the gentle and temperate Air that is continually perceiv'd in my little Room, be the Weather ever ſo cold, as ſoon as a Fire is made in it, were apprehenſive (as they told me) that being often in a place where no Cold is felt, they would catch cold in leaving it: But ought the fear of an uncertain, tranſient and imaginary Rheum or Cold in the Head, (as we ſhall make it appear) cauſe us to ſuffer a moſt exquiſite coldneſs of Weather for a very long time, with all the Inconveniencies that attend it? For fear of undergoing perhaps a little trouble for a few Days, ſhall we bear during Six Months ſucceſſively ſo great a Pain as exceſſive Cold is?

Men are not afraid of taking Cold every Morning, when they go out of a very warm Bed, to paſs into cold Places, and put on Cloaths that are no leſs ſo; or at leaſt this Fear in thoſe who may have it, does not hinder them from getting and keeping during the Night a convenient Heat, as long as they lie in their Bed; why then ſhould it obſtruct their doing

doing the ſame thing in the Day, while they continue in their Chamber? If in endeavouring to avoid the cold during the whole time they are confin'd there, they ſometimes get a Rheum, the heat of the Chamber does not cauſe it, nor contribute thereto; nay it even certainly hinders us from catching cold, and moſt commonly the ſharp Air that is felt in the Chamber occaſions that Accident.

When we go abroad equally warmed every where, and with a very gentle Heat, ſuch as is taken and retain'd by means of theſe Chimneys, and which is ſo proper to preſerve the regular Circulation of the Blood and of all the other Humours of the Body; we are leſs apt to get a Cold and be ſeiz'd with Chilneſs, than when we go out of a Place, where we are warm'd but on one ſide, and ſometimes ſcorch'd, as it happens about the ordinary Chimneys. The Heat that is ſpread thro' the whole Body, laſts a great deal longer than that which is only felt in one Part even ſo as to annoy it; but is not every where the ſame. If Argumentation be not ſufficient to convince you of the reality of this matter of Fact, take the following Experiment.

For eight or nine Years that I made uſe of theſe ſorts of Chimneys, and this manner of heating my Room, which was the Place of my conſtant abode during the whole Winter, I have not as yet taken cold ſo much as one ſingle time; tho' I us'd to do it before every Winter, and rather twice or thrice than once. The *Germans*, *Danes*, *Switzers*, and all the People of the North, as well as others in whoſe native Countries the Weather is colder than in *France*, and who to ſecure themſelves from it, only have recourſe to Stoves which ever give them a great deal of Heat, as long as they abide in the Places where they are warm'd; they do not complain at all of Rheums which they would be more ſubject to than People can in theſe Parts, ſince they live in colder Climates: Nay the Inconveniences that generally attend thoſe ſuffocating Heats of the Stoves do not hinder them from uſing the ſame, in order to rid themſelves of a Grievance ſo great and ſo tedious as is the cold of an entire Winter.

Very far from that, I have here ſeen ſeveral Perſons of Worth, Judgment and Figure of thoſe frozen Climates, making complaint to us of the Manner after which we warm our ſelves in *France* with our Chimneys: They could not bear it; that when a Man is very cold, he ſhould ſet himſelf before the Fire, only to ſee the Wood burn, at ſome diſtance from it, or to broil himſelf when he is near it; nor that one ſhould be oblig'd to ſtand or ſit double with his Head and Feet quite bent in a Chimney, in order to ſcorch his

Eyes, Face and Leggs, to prevent his being cold, when at the ſame inſtant he freezes in ſeveral other Parts; and that he ſhould thus warm himſelf only to augment his Grievances, and to feel in ſome Parts the pain of an exceſſive Heat, while in others, he ſuffers that of as violent a Cold.

And indeed in this reſpect, thoſe Gentlemen only recited a part of the Annoyances that happen in the manner of warming one's ſelf in *France*, with the ordinary Chimneys, and are avoided by making uſe of theſe New-invented Ones, which have all the Conveniences of Stoves, without any of their Diſadvantages. We have therefore no grounds to be afraid of uſing them, nor in ſo doing of getting a Cold; and ſhould we have one, it ought not to be alledg'd as a Reaſon to induce us to undergo all the Inconveniences of Cold and of the ordinary Chimneys, and to deprive our ſelves of the Advantages of this modern Invention.

CHAP. VII.

That the Exteriour Air which has paſs'd thro' the Cavities of the Chimney, in the ſhort time that the Fire is kindling there, gives Heat to the Room, notwithſtanding its ſtill appearing cold to us, as it enters.

Fig. 6. 17. WHEN the Weather is extreme cold, and the Fire begun to be lighted, the Air from without only paſſing thro' very cold Places, cannot but cool the Chamber in ent'ring it; ſo that the Aperture *R* may be ſhut up for a few Moments, till the Fire is kindled and the Cavities ſomewhat warm'd; but we ſhould thereby ſometimes expoſe our ſelves to the annoyance of Smoak, during the whole time that the paſſage of the Air is ſtopt: It is more expedient therefore in that caſe to leave it open, but to take care that the Fire kindle quick, and forthwith ſtrike upon the Ground-plate, which will be heated in an inſtant; and then the Air that paſſes thro' the Cavities, tho' it ſeem cold in ent'ring the Room, will not only forbear cooling it, but even give Heat thereto.

Foraſmuch then as this ſame Air when it only feels luke-warm and temperate, will nevertheleſs warm a Room more than the Air which is brought to circulate from that Room, tho' it ſeem very hot; ſeveral Experiments have given me Satisfaction as to the truth of both theſe Paradoxes, ſome of which are here inſerted.

EXPERIMENT I.

The Fire being lighted in my Chimney, I obſerv'd that the Liquor

quor of my *Thermometer* roſe no leſs, whether the ent'rance of Communication *R* for the Exteriour Air was ſhut, or whether it was open; and that the Air in paſſing thro' it to get into my Chamber ſeem'd cold to me; which is a pregnant Proof, that the Air of the Room was not cool'd by that freſh Air, which came from without, tho' it appear'd cold.

Fig. 9. 17.

A Remark.

To apprehend the reaſon of this and the following Experiments, it is requiſite to take notice, That beſides the general cauſe of Cold, which is the reſting of the Parts of Natural Bodies, or their ceaſing from Motion; the coldneſs of the Air alſo proceeds ſometimes from the quality of its Parts, ſometimes from their Determination, and at other times from both thoſe Cauſes together.

I. It proceeds from the quality of its Parts, when they are ſtiff, frozen, and almoſt void of Motion, or at leaſt mingled with Aqueous Particles that have thoſe Qualities; as they are in Winter, when it freezes very hard, and little Wind is ſtirring; this coldneſs of the Air acts ſtrongly upon every thing it touches, and more proportionably on Inanimate Bodies: For we ſee that Rivers, Trees, Plants, *&c.* freez ſooner and more ſtrong in this ſingle Diſpoſition of the Air, than when the Wind is very high, and that ſo much the more, as it has a greater mixture of congealed Aqueous Particles.

And in that Caſe, the Air is alſo exceeding ſmart upon Animal Bodies; becauſe the frozen Particles of Water, being as it were ſo many ſmall ſharp Needles not only touch and ſtrike the Skin, but even partly penetrate it, and ſo affect certain Parts which are more ſenſible than thoſe above the exteriour *Cuticle*.

Thus theſe congealed minute parts of Water being mixt with the Air, render the Cold ſo ſenſible in the Morning when the Sun riſes, and it has froze in the Night, eſpecially when there is a Hoar-froſt on the Ground: For the Sun raiſing thoſe frozen and ſtiff Particles, before it has diſſolv'd and made them flexible; they apply themſelves to all the Bodies they meet with, partly get into their in-ſide and cool them more than the cold of the Night had done.

II. The coldneſs of the Air proceeds from the Determination of its Parts, when they are violently puſh'd on the ſame ſide: By giving them this Determination, we render that Air ſenſibly cold or freſh, which at firſt appear'd hot to us; as when we agitate it with a Fan; or when after having caus'd it to enter at the Clack-holes of a pair of Bellows, we make it go out thro'

the Nozzle; or when we cauſe the Air to iſſue out of our own Lungs thro' the Mouth, by puſhing it forcibly, or by blowing very ſtrong: For in all thoſe Caſes, we experience that the Air which was warm, ſeems to us cold or freſh.

But this ſort of Cold which is not really ſo but with reſpect to us, ſcarce communicates it ſelf at all to inſenſible things that are ſolid, nor even to Liquids, when they are enclos'd in Veſſels. Upon this account, the Air which to us feels cold did not cauſe the Liquor of the *Thermometer* to fall in the preceeding Experiment; the following is another Tryal that I made and repeated ſeveral times.

I at firſt took upon me to blow for a very conſiderable time the Balls of two different *Thermometers*, with a pair of Bellows, the Air of which in going out to me ſeem'd cold: However the Liquors of thoſe Inſtruments were ſo far from falling, that they continually roſe; but more ſenſibly in cold Weather, when the Liquor was very low and but little rarified, before the blowing, than in hot Weather, when the Liquor was higher, and had attain'd to a greater degree of Rarefaction; tho' it was conſtantly in the Place, where the *Thermometer* had been a long while, which receiv'd the Air that enter'd thro' the Clack-holes of the Bellows.

Some time after, I likewiſe blow'd with my Mouth in a very long Glaſs-Tube, and the Air, tho' iſſuing out of my Lungs felt cold in ſtriking upon my Hand: But it caus'd the Liquor of the *Thermometer* to riſe more quick and higher than that which went out of the Bellows, becauſe the Air which is breath'd out of the Lungs, is mixt with a very great quantity of Vapours. I then fixt the ſame Tube to the Nozzle of the Bellows, and the Air that went out thro' this long Canal in coming near the Wings ſeem'd to me colder, than when the Pipe was only of its ordinary Length; yet in blowing on the *Thermometer*, it occaſion'd a no leſs riſing of the Liquor.

In all theſe Caſes, whether the Pipe of the Bellows was ſhort or long, whether the Wind iſſu'd out of that Inſtrument, or whether I blow'd in the Tube with my Mouth; the Air that paſs'd thro' the Nozzle, made a Wind that to me appear'd cold, and which nevertheleſs always caus'd the Liquor of the *Thermometer* to aſcend, either more or leſs: So then, that Air muſt go out of the Bellows hotter than it enter'd with reſpect to the *Thermometer*; ſince it warm'd the Liquor, and had no Cold but that of the Determination of its Parts, which is only cold with reſpect to Animal Bodies, when that Determination is not violent.

If we feel this Air cold, when the Parts that were hot take a Determination

termination in a Right-Line; this without doubt proceeds from hence, that thoſe Parts of the Air in paſſing on our Fibers, not only do not ſtay there, and ſo do not communicate to us their Heat or Motion: But even in regard that in paſſing quick, they carry away ſome of the hotteſt Particles we have, which encompaſs the Fibres of our Muſcles; or rather ſtop in that inſtant, and ſuſpend the Motion (in all reſpects) of thoſe minute Bodies, which occaſions in us a ſenſation of Heat.

And indeed, as ſoon as that Wind which ſeem'd cold to us, ceaſes, we have a no leſs hot one: By reaſon that the motion of the minute Parts which was ſtay'd or ſuſpended, begins again; and thoſe very Parts of the Air, with which we make a Wind, by giving them the ſame Determination, reſume their Motion in all Points, as ſoon as they are no longer violently puſh'd in that ſame Determination.

Thus the Wind that goes out of a pair of Bellows, when it is at ſome diſtance, muſt be almoſt as hot as it was when it enter'd the Clack-holes; and that which makes the ſaid Wind, rather warm than cool the Liquor of the Thermometer, apparently is upon account that not touching that Liquor by reaſon of the Glaſs in which it is enclos'd, it does not ſtop its Motion, as it does that of our Fibres: On the contrary, if ſome of the Particles of this Wind or of the Ethereal Matter it contains ſhould paſs through the Glaſs, (as it undoubtedly ſo happens) that which enters having more Motion, than the Parts of the Liquor have, rarifies and heats the ſaid Liquor inſtead of cooling it, as it would operate in Animal Bodies, were it immediately to blow upon them.

Neither ſhould we be ſenſible of this cold Air, if we had a Hand laid behind a Glaſs againſt which it blow'd, provided our Hand be not too hot. I have made an Experiment of it more than once, and in this Caſe perhaps we ſhould even find it hot, if our Senſe of feeling were ſufficiently exquiſite, or if we had only a Heat near upon equal to that of the Air, whereas we feel it cold when it ſtrikes directly upon our Hand; as we likewiſe experience that that ſame Air, is capable by its determination alone, to cool Liquors on which it paſſes with a direct Blaſt; after this manner we uſually cool Broth or Coffee, *&c.* that we are diſpoſed to take, by blowing very ſtrong upon it. *

* I made this Experiment ſeveral Years ago, and had already ſet it down here, when I found in the Hiſtory and Memorials of the Academy of Sciences *Anno* 1710. that ſeveral Perſons had likewiſe made it, and the Reaſons they gave upon that Occaſion: They therefore who are deſirous to ſee what has been ſaid in thoſe Memorials, may have reconrſe to them.

In

In like manner, tho' the cold Air from without in paſſing thro' the Cavities of the Chimney, grows warm there, nevertheleſs it muſt appear cool, (when the Fire has been kindled but a little while) in paſſing thro' the Aperture *R* into the Chamber: By reaſon that having as yet only acquir'd the Motion that might cauſe in us the ſenſation of a moderate Heat; if this Motion were ſingle, it would be eaſily ſurpaſſed by that which it attains to on the ſame Side, being pent up, preſs'd cloſe, and violently puſh'd, and that gives all Parts the ſame determination in a Right-Line; which they loſe, as ſoon as they are got at ſome diſtance from their Out-let *R*, and are no longer conſtrain'd nor puſh'd.

Upon that Account this freſh Air cannot cool that of the Room, where it enters, nor the Perſons that are therein, provided they be not near nor over againſt the Place thro' which this Air comes in, during the time that its Parts not being able to diffuſe themſelves on all Sides, retain their determination in a Right-Line: And in regard that this Air in paſſing into the Room muſt expel the ſame quantity of that which is there; if after having enter'd and loſt its Determination in a Right-Line, it is become leſs cool or more warm than that which goes out, it muſt give Heat to the Chamber, and cauſe the Liquor of the Thermometer to riſe as it happens in this Experiment.

III. Laſtly, the coldneſs of Air proceeds from the quality and determination of its Parts both together, when thoſe Parts being congealed or mixt with frozen Aqueous Particles, and every one of them in particular ſcarce having Motion any longer, they are all puſh'd by a like Motion in a Right-Line; as it happens in Winter, while the Winds are high, eſpecially when they blow from the North: And this cold of the Air is always more ſenſible, and ever acts more ſtrongly upon all Bodies, than when it only proceeds from the ſingle determination of its Parts, and alſo makes the greateſt Impreſſion upon Animal and ſenſible Bodies, and ſo much the more, the more tender they are; by reaſon that the ſaid violent Motion cauſes the ſtiff frozen Particles to penetrate into the ſurface of the Skin and Fleſh.

But the ſame Cold of the Air operates leſs upon Inanimate and Inſenſible Bodies, than when it only takes riſe from the quality of its Parts, and has not that violent Motion nor that ſtrong determination in a Right-Line 1. Becauſe theſe Parts always have a certain Motion, which thoſe that are depriv'd of that ſort of determination have not. 2. By reaſon that theſe ſame Parts paſs above the ſolid Bodies, which they ſtrike, touch, or are reflect-

ed

ed back or ſtay leſs upon, than when they are almoſt quite void of Motion and without Determination. Thus this Determination of the Parts of the Air in a Right-Line ſometimes diminiſhes the Heat with reſpect to Animal and Senſible Bodies; and on the contrary, ſometimes abates the Cold, and cauſes what is left of it to act leſs violently upon Inſenſible Bodies.

And indeed, we often experience in Winter, That from the ſame North-Wind it freezes a great deal leſs ſtrong when it is vehement, than when it blows with leſs force or ceaſes; and on the contrary, the South-Winds in the great Heats of Summer, do not forbear appearing cool to us, when they are high, altho' the Thermometers riſe no leſs than when they are almoſt ceas'd and ſeem to us a great deal warmer. This Article ſhall have its Application in the third and fourth Experiment.

EXPERIMENT. II.

I have alſo experienc'd that the Exteriour Air which enter'd at the Aperture *R*, after having paſs'd thro' the Cavities, appearing to me moderately warm, and very temperate, heated my Chamber a great deal more, and caus'd my Thermometer to riſe higher, than the Air of the Room did, in circulating thro' the ſame Places, altho' it ſeem'd to me very hot at its going out.

Fig. 6. 17.

One of the Reaſons of this Experiment is ſet forth in the ſecond Article of the preceeding Remark: For the Air taken from without after having grown hot in the Cavities of the Chimney, and ent'ring the Chamber with Impetuoſity, is, or appears cold to us, only by the determination of its Parts in a Right-Line; and therefore is not ſo, but with reſpect to thoſe that are near the Place where it goes out. But this very Air as ſoon as it is removed from thence, loſes that momentany and relative Coldneſs, and is become as hot or hotter than that of the Room, after the latter has circulated in the ſame Cavities, and paſs'd at ſome diſtance from the Aperture thro' which it iſſu'd out.

A ſecond Reaſon of this Experiment may be that the Exteriour Air enters in a greater quantity than that which is taken in the Chamber, becauſe it paſſes with a great deal more Celerity.

The third Reaſon is, That the Air which is brought from the Room, and made hot by cauſing it to circulate thro' the Cavities, does not warm of it ſelf, after it is gone from thence, all the Air with which it mingles together, but by communicating thereto the Heat it has contracted, which how conſiderable ſoever it may be, is nevertheleſs a ſmall matter in compariſon of the Cold

Cold that is in the whole Body of Air ſpread in the Room: But the Air which is drawn from without, in ent'ring drives away as much cold Air in order to take its place, as we have ſhewn in the third Chapter; and after this manner warms the Chamber, in expelling the cold Air and cauſing it to be ſucceeded by hot; and conſequently gives more Heat thereto, and with greater ſpeed, even when it only enters temperate, than the Air of the Room does when it comes in hot.

The fourth Reaſon is, That the Air which enters from without, continually keeps the Chamber as full as it can be, and by that means hinders the ent'rance of as much cold Air from other Places thro' all the little Paſſages it might find out.

To conclude, the fifth Reaſon is, That when the Exteriour Air enters, that of the Chamber is always more preſs'd, ſo that a greater quantity thereof touches and encompaſſes the ſame Body; 'tis capable therefore of heating it more and quicker with the ſame Heat, than the ſingle Air of the Room would do, if no freſh were got in: It can alſo by this great preſſure, cauſe to paſs into the Bodies it ſurrounds ſome of its moſt ſubtil Parts, even thro' the Glaſs of the Thermometer, and cauſe the Liquor therein to riſe higher, and give it a greater degree of warmth than it would do, if its Action of preſſing were leſs, tho' in both theſe Caſes it had the ſame Heat.

EXPERIMENT III.

I often apply'd the Ball of my Thermometer to the place *R*, thro' which the Exteriour Air iſſu'd out, after having paſs'd thro' the Cavities of my Chimney, and how cool ſoever the Air appear'd to me, when a Fire was firſt lighted, which did not ſuffer it to continue long in that ſtate of Coldneſs as it was without; the Liquor never fell, but often roſe, tho' the Air that enter'd thro' my Window, and did not ſeem to me a whit cooler, made it ſink conſiderably and very ſenſibly. In applying then this Air which comes from without, tho' it appear ever ſo cold in paſſing thro' *R* into the Chamber, yet it cannot cool it, when there is a Fire in the Chimney. *Fig.* 6.

We have pregnant Reaſons of this Experiment in the ſecond and third Articles of the foregoing Remark: For the Air which paſs'd thro' the warmed Cavities has no more Cold than that which is given it by the determination of its Parts in a Right-Line, which can neither cauſe the Liquor of the Thermometer to fall nor cool the Air of the Chamber, as we have already ſhewn in the ſecond Article of the Remark: But the cool Air that came in thro' the Window, was colder by the

the quality of its Parts (for the Weather was froſty at that time) than by their determination, and ſo it muſt needs act ſtrongly upon the Thermometer, and make it fall conſiderably; as it would alſo have very ſenſibly cool'd the Air of the Room, if it were ſuffer'd to enter in that Condition, as we have elſewhere explain'd.

EXPERIMENT. IV.

I again expos'd the Ball of my Thermometer to the Air that came from without Doors, and enter'd the Chamber thro' *R*, after having been ſufficiently heated to appear to my Touch luke-warm and temperate; and afterwards to the Air of the Chamber, which went out at the ſame Place *R*, and to my apprehenſion was very hot: This being done alternately ſeveral times to both thoſe Airs, the Exteriour one which ſeem'd luke-warm, continually caus'd the Liquor to riſe as much as that of the Room, which appear'd extreme hot. Now this is another Proof, that the Air which came from without, enter'd as warm as that which circulated from the Chamber, and that its Determination in a Right-Line only made it appear leſs hot, near the Aperture thro' which it iſſu'd out; and that it muſt therefore give more warmth to the Room, than the other which ſeem'd hot; becauſe it heated it, not only in mingling together with the Air it met with there, but even in driving the ſame Air away, as it made its Entrance.

Fig. 6.

The ſecond and third Articles of the Remark, with the firſt, ſecond and fifth of the Second Experiment, contain the Reaſons of this laſt Tryal.

For 1°. The Exteriour Air that had paſs'd thro' the Cavities of the Chimney, and to my apprehenſion was only luke-warm had a determination in a Right-Line, which muſt indeed make it appear leſs hot than it really was in it ſelf, and with reſpect to the Thermometer.

2°. This outward Air ſtruck more ſtrongly near the Thermometer, than that which came from the Chamber; ſo then more of its Parts at the ſame time encompaſs'd and warm'd the Ball and Liquor of the Thermometer: It might alſo in preſſing it more than that of the Room, cauſe ſome or even a conſiderable quantity of its moſt ſubtil Parts to enter thro' the Pores of the Glaſs, which would augment the Rarefaction of the Liquor more ſenſibly than the Air of the Room had done.

It may then be concluded from the preceeding Remarks and Experiments:

1°. That it is not neceſſary, that the Air which is taken from without Doors, in order to be

brought into the Cavities of the Chimney, ſhould enter the Chamber very hot, to give it a due warmth; but it is ſufficient that it come in temperate.

2°. That we ought not to paſs a Judgment of Cold and Heat with reſpect to our own Conſtitution and for our ſelves, by the Effects that either produces on Inanimate Bodies; ſince that which renders the Cold of the Air more ſenſible in reference to us, as the violent determination of its Parts in a Right-Line, on the contrary makes it act leſs upon Inſenſible Bodies.

3°. That thoſe Perſons are very much miſtaken, who with an intention continually to have the ſame degree of Heat, would keep in their Chamber, ſuch a one as makes the Liquor of their Thermometer riſe to the ſame height: For if that degree of Heat were really always the ſame, and their Thermometer were not alſo as uncertain as we have elſewhere obſerv'd that it is, they would almoſt ever feel a different Heat, accordingly as they themſelves are more or leſs hot.

There are very few who have not experienc'd, That the Air of of Cellars appears cool in Summer, and warm in Winter, nevertheleſs it has been frequently taken notice of, that the Thermometer is at the ſame height during Winter and Summer in thoſe Places; and I have found it to be ſo in ſeveral Years: But in Winters when the Weather has been very cold, I perceiv'd that the Liquor of the Thermometer was lower in a Cellar than in Summer; and in the Year 1709. it ſubſided to 18 Degrees *i. e.* two Degrees below that which uſually denotes Froſt, and indeed it did actually freeze there, tho' the Air did not appear cold; and in Summer, it was riſen up to 60 Degrees in the ſame Cellar, where the Air ſeem'd cool at that inſtant of time.

If ſuch particular Experiments were required, as all Perſons might make every where at all times, and which would evidently ſhew, that the ſame Air appears warm or cool, according to the different Diſpoſitions any Perſon is in, or the different degrees of Heat or Cold that he is ſenſible of; 'tis only requiſite to heat one Hand and leave the other cool, and at the ſame time to pour luke-warm Water on both, or to let a temperate Wind blow upon them. Then the Party will feel the Water or Air cold on the warm Hand and hot on the cool one: Becauſe every thing that has more Motion or Heat than we have, and communicates either to us, is hot to our apprehenſion, and every thing that has leſs of that quality, or deprives us thereof ſeems cold; for the Senſes only judge, or rather cauſe us to paſs a Judgment of things, with reſpect to us, or our Temperament.

Now

Now the luke-warm Water and the Temperate Air having leſs heat than the warm Hand, but more than the other that is cool, they communicate part of their warmth to the latter, and take it away from the former: Thus according to the different Diſpoſitions we are in, the ſame Heat appears to us to have different degrees, and it is requiſite we ſhould have ſuch as ſeems convenient for us; and the Heat which we feel too vehement be it what it will, is really too great for us; the ſame thing is to be affirm'd with reſpect to Cold.

We are therefore to judge by our Senſes of the Degrees of Heat and Cold that are agreeable to us, and not by what exteriour Objects more eſpecially inanimate ones may repreſent to us; and notwithſtanding that the Thermometer ſhews us ever ſo fairly, that the Air of our Chamber is very hot; yet if we feel it cold, it is abſolutely neceſſary to encreaſe its Heat.

PART. III.

Of the Diſpoſitions of the Shaft and top of a Chimney, to augment and preſerve Heat; or to quench by one's ſelf in an inſtant, any Fire that may happen to catch there; and of Means to retain Heat during the Night, after the Fire on the Hearth is put out.

CHAP. I.

Of the Exteriour Aperture of the Funnel of a Chimney, contriv'd ſo as to encreaſe Heat.

TO the end that nothing may be omitted, which is in any wiſe capable of contributing to render the Chambers warm, or to the exteriour Diſpoſitions of the Funnel, in order to encreaſe Heat; we ſhall here add certain ready Methods to keep it all Night, when there is no longer any Fire on the Hearth.

I Know not whether a due Reflection was ever made, That regard ought to be had to the Diſpoſition on the top of

of the Funnel of a Chimney, in order to augment or retain the Heat of a Chamber; however, the Winds that are but too often found ent'ring at the top of Chimneys, and which exceedingly cool the Rooms, require that this matter be taken into conſideration.

When the Aperture of a Chimney is too large; by reaſon that the Air at firſt begins to grow hot but a little in the Chamber, two Columns at leaſt are form'd in the Chimney, one of Smoak that riſes up, and the other of Air which goes down: And this Accident, tho' it be not always ſo conſiderable as to raiſe in the corners of the Hearth thoſe ſmall Whirl-winds that are ſometimes ſeen there, or to beat the Smoak down; as it very frequently happens, when the Winds are violent; nevertheleſs it is always ſufficient to cool the Chamber, and to annoy a Perſon ſo far that he can ſcarce get any warmth therein: It is true, that thoſe Rooms are not ſo liable to ſmoak, unleſs it be occaſion'd by high Winds; yet it is alſo almoſt impoſſible to warm them in cold Weather.

To avoid this Inconvenience, 'tis requiſite to leave but a moderate Aperture at the top of the Funnel on the out-ſide, and ſuch as is neceſſary to give a free Paſſage to the Smoak. It is a general Cuſtom at *Paris* to diminiſh in this manner all the Apertures on the top of Chimneys, but with a view only to hinder their ſmoaking: And ſince this Precaution, (at leaſt when it is ſingle) for the moſt part proves fruitleſs, ſuch a diminution of that Aperture may alſo be often neglected without dammage; yet it muſt be abſolutely made a great deal leſs than the Tunnel of the Chimney is in its courſe, if one would have any Heat kept in the Chamber; beſides it is expedient that this Aperture have ſeveral Partitions, to the end that the Wind in dividing it ſelf may enter with greater Difficulty. *Fig.* 32.

Foraſmuch as it is neceſſary to give the Aperture a peculiar Diſpoſition, in order to prevent the Annoyance of Smoak, and this very Diſpoſition may alſo contribute to encreaſe the Heat of the Room; we refer the treating of this Subject more particularly to the next Book, in which ſhall be laid down proper Means to hinder the ſmoaking of Chimneys.

CHAP. II.

An eaſy Method to quench Fire by one's ſelf in the Funnels of Chimneys in an inſtant, and to preſerve Heat in the Rooms during the Night.

FIRE, which too often happens in the Funnels of Chimneys, ſome times occaſions conſiderable

derable Dammage, and always a great deal of Fright: It is true indeed, that theſe new-invented Chimneys are not ſo ſubject to this Inconvenience, becauſe a leſs quantity of Soot is made therein, and it may be further prevented by ſuffering ſtill leſs to gather together; but tho' this Accident almoſt always comes by our own default, yet it muſt be remedy'd whenever it falls out.

To hinder then in an inſtant, without the aſſiſtance of any Perſon, the effect of Fire which may ſuddenly break out in the Funnel of a Chimney, it is requiſite to provide for the top on the In-ſide a Regiſter-Plate, of Iron exactly of the length and breadth of the Tunnel in the Place where it is to be fixt; ſo as it may, (as occaſion requires) ſtop up the Aperture of the Chimney or leave the Paſſage free by means of two Wires faſten'd at each end, as we ſhall ſhew in the third Book; another Regiſter-Plate is alſo to be ſet at the bottom of the Funnel, which may be likewiſe open'd and ſhut at pleaſure. *Fig.* 34.

When a Chimney is at any time actually on fire, the Brands or Coals are firſt to be taken away, and the Wires afterwards drawn, which may fix the two Regiſter-Plates or * *Devices* but now menti-on'd in their Horizontal Situation, and ſhut both the top and bottom of the Funnel, and the Fire within will immediately go out: For beſides that no Air can enter; the rarefaction of the Parts of the Smoak, and the Elaſtick force of thoſe of the Air that are pent up, encreaſing by the Heat, and not being able to ſpread, nor iſſue forth either at the top or bottom; they'll preſs ſtrongly on the Parts of the Matter that is burning, ſtop their Motion, and hinder them from ſeparating, and conſequently obſtruct the burning of the whole combuſtible Matter, and ſo quite extinguiſh the Fire.

* *Baſcules.*

It were indeed ſufficient abſolutely to ſhut one of the Regiſter-Plates, but then the Fire would not go out ſo ſoon; and if the Upper were only ſtopt, the Smoak would turn back into the Chamber, till the Fire is entirely quench'd; which Inconvenience, tho' great, one would nevertheleſs ſometimes willingly bear with, to avoid the dangerous Conſequences which may enſue from a Fire that burns a long time in the Tunnel of a Chimney.

If there be no Regiſter-Plate at the bottom of the Funnel to keep out the Smoak, you may, before the Upper one is ſhut, ſtop up (as is uſually done) the fore-part of the Chimney with ſome ſort of Cloth, that is wet, if you think fit; and then there will be no neceſſity to take away the burning Brands, on which a little Water may be thrown, the Vapour where-

of

of will cauſe the Fire to go out ſtill more ſpeedily. As ſoon as it is thus quench'd, the Regiſter-Plates are to be ſet again in their Vertical Poſition, and the Wire of that on the top of the Chimney hanged upon a Hook, to the end it may not get out of its Place, and hinder the Smoak from iſſuing forth, when the Fire on the Hearth is kindled.

By this expeditious and ready means the ſad effects of ſuch a Fire may be avoided, as alſo that of the Viſits which too many People generally make upon thoſe Occaſions.

And farther, theſe Devices may ſerve to keep Heat in the Chambers during the Night, when there is no longer any Fire; for in ſhutting either of the Regiſter-Plates, when we retire in the Evening or are going to Bed, it will hinder the warm Air of the Room from iſſuing out, and the cold Exteriour Air from ent'ring in: But it is requiſite before the ſaid Plate is ſhut, to quench all the Brands, and only cover them with Coals or Embers that do not ſmoak, if we are diſpos'd to leave any Fire.

The Regiſter-Plate being ſhut, eſpecially if it be that on the top, will alſo hinder the Smoak of an adjacent Chimney from getting into one's Chamber, when there is no Fire in it; and ſo may be often us'd to very good purpoſe, even in the Summer-ſeaſon.

CHAP. III.

*Of the Conveniences of the Aſh-hole and * Fire-cover, to preſerve Heat in the Night.*

* *Couvrefeu.*

Fig. 6. 17. IF near the Ground-Plot of a Chimney, a Cavity be made in the middle of the Hearth about an Inch in depth, it will be of good uſe to retain the Aſhes, which may be ſo diſpos'd as to fall into it from time to time, in order to keep the Hearth clean; and with theſe Aſhes the Fire may be cover'd in the Evening, and by that means eaſily preſerv'd till the next Day; as is uſually done in the Convents of *Carthuſian* Monks.

And the Fire being thus cover'd, will keep (in the Night) the Aſh-pan and the whole Hearth-plate in a moderate Heat, which is ſufficient to communicate ſome of it to, or at leaſt ſecure it for the whole Volume of Air that paſſes into the Cavity underneath, (if there be ſuch a Cavity) when it is only taken from the Chamber; and to maintain it in a warmth which may be ſtill felt in the Morning, if the cold Air be not let in during the Night.

After this manner by ſtopping the Communication of the Exteriour Air, and only leaving the Chamber-Air to paſs thro' *D y* into the Cavities of the Chimney

ney; it will be found very warm again in the Morning, be the Weather ever ſo cold, eſpecially if the fore-part of the Chimney is likewiſe ſtopt, to the end that the warm Air may not go out, nor the cold enter thro' that Place; or if one of the Regiſter-Plates, deſcrib'd in the fore-going Chapter, be let down, with the above mention'd Precautions.

And in caſe we do not content our ſelves with covering the Fire in the Aſh-hole with Aſhes, but are alſo diſpos'd to apply a Fire-cover, that is to ſay, a kind of Box without a Lid, of Tin, Iron, or Copper, the Conſtruction and Uſe of which muſt needs be well known; by that means ſtill more Heat may be kept in the Night, and the Fire lighted in the Morning with greater eaſe and ſpeed; neither will there be any grounds of Fear upon account of that which was left on the Hearth.

For if after having cover'd the Wood-coals or Embers with Aſhes, the Billets are laid upon them ſpread in any form whatſoever, and the Fire-cover ſet over all, (which cloſes every where at the bottom of the Hearth, ſo as to let in very little or no Air;) the Fire of the Billets that lye underneath, will go out, except that at moſt, which bears on the Aſhes, and that of the Embers which are cover'd with the ſame Aſhes.

So then, thoſe Billets will be found in the Morning almoſt as entire as they were in the Evening when they were cover'd, and as yet warm: They'll alſo maintain the Heat of the lower-part of the Hearth without burning, and by conſequence that of the Air of the Chamber which is left to circulate therein by hind'ring the entrance of the Exteriour Air. Whereupon, when after the Fire-cover is taken off in the Morning, you ſtir the Aſhes a little, to diſcloſe the Fire that lies hid underneath, and open the Vent-hole; the main Body of the Fire will kindle in an inſtant, eſpecially if care be taken always to leave ſome Brands, before it was cover'd.

BOOK II.

Of the Diſpoſitions of the new-invented Chimneys, to hinder their Smoaking.

IT is certain that endeavours have been us'd with greater Application, to avoid the incommodities of Fire, than to ſearch into its Conveniences: However Smoak, ſo common in all cloſe Places where Fire is made, and yet ſo troubleſome in

ſo

ſo many Reſpects, has perplex'd a great number of Architects, who have taken much Pains in ſeeking for means to hinder it, but to no purpoſe; ſince complaint is ſtill made of it at this Day as much as ever, and all the Devices that have been hitherto found out, publiſh'd, or put in execution, have at moſt but diminiſh'd one of the Cauſes of that grievous Annoyance, without being able abſolutely to remove it: Neither does it appear that the moſt general Source of it is as yet known, as we ſhall ſhew in its proper Place; at leaſt it is but too evident that no effectual Remedy is diſcover'd.

The Inconveniencies I ſuffer'd by Smoak, during a very ſharp Winter, in an Apartment which otherwiſe I had no mind to quit, induc'd me to ſeek after the Cauſes of Smoak, and the means of remedying it, which are here laid down in this Book. It were indeed to be wiſh'd that they might prove as uſeful to the Publick, as they have been ſerviceable to me ever ſince that time.

PART. I.

Of Smoak, and of the Diſpoſitions of the fore-part of Chimneys to prevent it.

THE ſame Diſpoſitions of the Interiour fore-part of Chimneys which have been given in the third and fourth Chapters of the firſt Part of the firſt Book, to encreaſe Heat, and reflect its Rays, do likewiſe contribute to hinder the ſmoaking of Rooms; but for the more clear apprehending of this Matter, it is requiſite in the firſt Place to enquire into the cauſes of Smoak.

CHAP. I.

Of the Cauſes of Smoak in Chambers, with ſome Reflections upon the qualities of Air.

THE Cauſes of Smoak, the annoyance of which we are ſenſible of in the Rooms, are either Internal and External.

The Internal Cauſes, that is to ſay, thoſe that are met with on the in-ſide of the Chamber or Chimney,

Chimney, are firſt the kinds of *Vacuum*'s, which happen in the Places where there is any Fire, eſpecially when they are very cloſe; and theſe *Vacuums* take their riſe as follows:

1°. In regard that the Air rarifies by Heat, and conſequently leaves many intervals between its Parts, or many Spaces fill'd with Matter which reſiſts the Smoak leſs than the Parts of Air would do, whoſe Place it takes up and poſſeſſes.

2°. Upon account that ſome part of the Air of the Chamber goes out with the Smoak: Thus that which the Fire inceſſantly makes, being not ſo much preſs'd by the Interiour Air which continues in the Room, as by the Exteriour Air ranging at the top of the Chimney, it paſſes into the ſaid Room, and occaſions the Inconveniences which are ſo often perceiv'd there.

3°. By reaſon that the Air of a Chamber in like manner iſſues out, when a Door is open'd that has a Communication with ſome other warmer Place, and ſo gives means to the Smoak to turn back into the Room, where it undergoes a leſs Preſſure than without; which would alſo happen in opening a Door or Window, on the ſide oppoſite to that from whence the Wind blows.

This kind of *Vacuum* which happens in a Room, after what manner ſoever occaſioned, is the principal Interiour Cauſe of Smoak; which Grievance none has as yet taken care to redreſs, tho' it is become Univerſal.

We may alſo look upon as an Internal Cauſe of Smoak, the too great quantity of Soot that is in the Chimney, and even the groſs Air with which it is fill'd, when a Fire is firſt begun to be lighted; both hindering for that time the Smoak from riſing up, and going out ſo readily: But it is an eaſy matter to remedy one by cauſing the Chimney to be ſwept, and the other by leaving ſomething a little open on the ſide that the Wind comes, if it can be done, when we go about to make a Fire.

Laſtly, the ordinary diſpoſition of the Jambs, Breaſt and Draught of Chimneys, and the manner with which moſt part of the Funnels or Flues go winding about, are alſo internal Cauſes of Smoak, as we ſhall ſhew in the following Chapter.

A REMARK.

We have made it appear in the firſt Chapter of the ſecond Part of Book I. by many Experiments, That the hotter Air riſes above that which is leſs warm; ſo that it cannot be doubted but that Heat in warming the Air renders it more light; yet it does not follow from thence, that this greater Levity of the Air cauſes the Smoak to turn back into the Rooms, as many People give

out. It ſo happens indeed, becauſe the Air of the Chamber preſſes leſs upon the Smoak to make it go out thro' the Chimney, when hot, than when it is cold; but this leſſer degree of Force and Preſſure does not proceed from the greater Levity of the Air given it by Heat: For if the force which the Air may have, takes riſe from its Gravity, it is not from the Gravity of the Chamber-Air only, but from that of the *Atmoſphere*. Now ſuppoſe the Air of the Room, after it is ſufficiently grown warm, weighs a quarter or half leſs than it did when cool; this does not diminiſh the Gravity of its whole Column, nor conſequently its Force or Preſſure a Ten-thouſandth or a Twenty-thouſandth part; neither is the Quick-ſilver leſs preſs'd, nor riſes to a leſs high Degree in the *Barometer*.

This little abatement therefore of Force in the Air cannot occaſion the Smoak's having a leſs preſſure in the Chamber, nor conſequently its returning into it again; it muſt even for that reaſon not enter at all, or go out as ſoon as it is got in: For the Air in the Chimney is ſtill more rarify'd than that of the Room, and its Column higher, ſo that its Gravity muſt be more diminiſh'd on that ſide; but the greater or leſſer Degree of Gravity in the Air of the Chamber or Chimney is of no moment in Practice.

And if the Quick-ſilver of the *Barometer* falls, when the Chamber-Air is very much heated, (as it may happen) it is not upon account of its being leſs preſs'd by the Exteriour Air that is in the Room, but becauſe it is more preſs'd at that time above its upper Surface, by the Interiour Air which is continually above the Quick-ſilver on the top of the Tube; and by reaſon that the great Heat rarifies ſufficiently to make the Quick-ſilver ſubſide, as one may be convinc'd thereof by heating that part of the Tube.

The cauſe of Smoak then cannot be attributed upon this occaſion to that pretended greater Levity of the Air, but to the kinds of *Vacuums* which are therein, for the Reaſons but now given in the preceding Articles.

The External Cauſes of Smoak, that is to ſay, thoſe which are without the Chamber and the Chimney are 1°. The Exteriour Air that is above the Chimney, and hinders the Smoak from going out. 2°. The Winds which do not only obſtruct the Paſſage of the Smoak, but even beat it back into the Chimney, where they themſelves ſometimes enter with ſo great Violence, that they blow the Aſhes and Embers about the Room. 3°. Laſtly, the exceſſive largeneſs of the Aperture on the top of the Tunnel, or its being diſpoſed too far longways.

Air

Air hinders Smoak from iſſuing out of Chimneys, 1°. When it is very thick, becauſe the Smoak cannot ſo eaſily divide it. 2°. When the Chimney is commanded or overlook'd, tho' the Weather be very calm and the Air ſerene; by reaſon that the Parts of the Air ſtirring in all Points, the oppoſition they meet with on one ſide, diminiſhes the Spaces that are between them, augments their Elaſtick Force, and occaſions that the Smoak which tends to go out thro' the Aperture of the Funnel, finds a ſtronger reſiſtance there, is more preſs'd, and has a greater difficulty to work it ſelf into the Air in order to get thro' and divide it.

As for the Wind, it likewiſe hinders Smoak from making its way out in many reſpects.

1°. When the Chimneys are commanded on any ſide, as when they ſtand near ſome great Building, or near a Steeple, Tower, a Flag ſet up on high, the top of a Hill, *&c.* they are apt to ſmoak, tho' the Wind be ſcarce ſenſible; eſpecially when it comes from the ſide oppoſite to that which commands them; by reaſon that meeting with Obſtacles in all thoſe Particulars, it ſtays above the Chimney, and even enters by virtue of its Elaſticity, or Spring, which is encreas'd; as we ſee Paſte, Wooll, or a Spunge that is preſs'd extend or dilate it ſelf on the ſide where it has leſs Preſſure.

2°. When the Winds are boiſterous, the Inconvenience is ſtill greater, becauſe thoſe Winds do not only hinder the Smoak from going out, but even cauſe it to ruſh in with Impetuoſity: For the Air which is in the Chimney, what Smoak ſoever may be there, is continually more rarify'd, and leſs preſs'd than the Exteriour Air is, when the Wind blows and paſſes on very quick; and if it does not always get into the Chimneys in paſſing over them Horizontally, it ſo happens, becauſe the ſaid Air finds a free Paſſage before it: After the ſame manner, Water that is ſquirted with a Syringe along a bored Table, does not enter thro' the Holes which are underneath, as long as it meets with no reſiſtance before it; but if it be ſtopt by any Obſtacle, it ſpreads on all ſides, and falls thro' the Holes under the Table; and that more eaſily than it would run off on the ſides, by reaſon of its Gravity.

Now the rarify'd Air, or the Smoak, that is in the Chimney, acts with reſpect to the Exteriour Air, as Gravity does in reference to Water in this Inſtance; that is to ſay, this Wind or Exteriour Air, being leſs preſſed underneath over againſt the Funnel, it paſſes into the ſame when it finds before it ſelf an Obſtacle which encreaſes its Force and Spring by Preſſure.

3°. When a Chimney is very near ſomething that commands it, and the Wind is high, it may alſo occaſion its ſmoaking, tho' it comes from the ſide on which it is commanded: Becauſe the oppoſition the Wind meets with augmenting the Elaſtick Force of the Air, which in that place can only extend it ſelf upwards; when it has paſs'd above that which made the Obſtacle, it forthwith ſpreads downwards, and ſo drives back the Smoak into the Chimney, where it finds little reſiſtance.

4°. Altho' a Chimney be not commanded or overlook'd on any ſide, yet ſometimes the Wind does not forbear to enter it, when it ſcours or runs along the length of its Aperture; eſpecially if the ſaid Aperture be in form of a Parallelogram, as has been already hinted. And this may even ſo fall out, what Situation ſoever that Chimney may have, when a North Wind is predominant; becauſe this Wind uſually blows from top to bottom, and conſequently is capable of paſſing into all Chimneys that are open at the top.

To conclude, it is evident that the too large Aperture of a Chimney on the top, upon account that the Wind may eaſily lodge itſelf therein, and its diſpoſition long-ways; in regard that the Wind may ſcour its length, do ſometimes contribute to its ſmoaking. Theſe are the Cauſes which (according to our Judgment) may occaſion ſmoak in the Chambers; and we ſhall lay down the Means that appear to us moſt proper to prevent this Inconvenience, after having ſhewn that the Diſpoſition of the ordinary Chimneys is one of the Cauſes that produce the Effects of Smoak therein.

CHAP. II.

That parallel Jambs, the inclined Situation of the Breaſt or Lower-part of the Concave, and the manner after which the Funnels are carry'd winding about, contribute to the ſmoaking of Chimneys.

IN the ordinary Diſpoſition of parallel Jambs, the Smoak eaſily ſpreads its ſelf in the Corners *C B A*, *c b a*, *Figure* 1. and being ever ſo little agitated it ruſhes into the Chamber.

1°. By reaſon that not being any longer above the Fire, which does not extend to thoſe Corners, it is leſs puſh'd upwards in thoſe Places.

2°. Becauſe thoſe Parts being leſs heated, the Air of the Room is leſs attracted thereto, and by Conſequence repels the Smoak with leſs Vigour.

3°. In regard that the Air of the Chamber ſtriking with greater Force upon the middle of the Chimney, where the Heat is that has the attractive Faculty, in ſpreading

ſpreading by its Rarefaction, it alſo preſſes the Smoak in the Corners of the Chimney, and gives it a Motion which cauſes it to recoil and go back into the Room.

4°. Becauſe this ſame Air of the Chamber does ſcarce any longer puſh the Smoak, as ſoon as it has paſs'd the Mantle-piece of the Chimney, by reaſon of the Breaſt, *o i r*, which it finds void and heated, and which ſuffers it to riſe forthwith and dilate it ſelf freely about. *Figure* 3.

5°. Upon account that if it ſhould happen that the Air ſtrikes forcibly in the Chimney, as when there is a Door or Window open in the Chamber, or if a great quantiny of it come in thro' any Paſſage whatſoever, this Air violently preſſing upon the Smoak, cauſes it to ſtrike directly againſt the Ground-plot of the Chimney, and reflect into the Room, where if it be again ſtrongly repell'd, it makes thoſe little Whirl-winds that are ſeen in the Corners of Chimneys, and which are greater when the Winds enter thro' the top of the Funnel, and beat the Smoak back. *Figure* 1.

As for the Breaſt of the Chimney *o i r*, it contributes to its ſmoaking, not only, becauſe in ſuffering the Air that paſſes from the Chamber into the Chimney eaſily to riſe and ſpread, it diminiſhes its Force with reſpect to the Smoak; but even by reaſon that the ſpace of the Breaſt *m i o r* growing hot, the rarify'd Air which continues there, does no longer ſufficiently preſs the riſing Smoak: It ſtrikes therefore near the *Talus o i r*, is reflected back there, and paſſes again into the Room; for it does not follow in every reſpect the Laws of the Rays of Heat: And in beating upon the Surface *o i r*, the greater part ſpreads it ſelf on all ſides; as Liquids do, eſpecially when they ſtrike as they are riſing. *Figure* 3.

Smoak is alſo often reflected into the Chamber by ſtriking near the * ſmall Iron-Band of the Funnel of Chimneys that are carry'd bending back; becauſe the Turning or Inclination of that Band beginning at the top of the Jamb in *B*, the Smoak *D E* which meets with reſiſtance in that place, is reflected back and goes down, even more than it would do if it ſtruck higher in *L*; for its Force diminiſhes as it departs farther from the Fire; and yet upon account of the little deſcent it makes from *E*, it paſſes into the Room again. If any one is deſirous to be convinced thereof by Experience, let him put a ſmoaking Fire-brand in the Corner of the Chimney under *B*, and afterwards in the middle under *L*; and he'll ſoon perceive that the Smoak which ſtrikes in *E* will go back *Figure* 24.

* *Languette.*

back into the Chamber, and that it will not do it, at leaſt ſo ſenſibly, when it ſtrikes directly in *L*.

CHAP. III.

That the Diſpoſition of the Jambs in Parabolical Lines, the Horizontal Situation of the lower part of the Concave, and the Funnels carry'd in Curves, when made winding, are moſt proper for hind'ring the Annoyance of Smoak.

BY giving the Jambs of a Chimney a Parabolical Diſpoſition, and the lower part of the Concave, or Chimney-piece, an Horizontal Situation, and by making the bottom of the Band of winding Funnels in form of a Curved Line, we may ſupply the Defects but now obſerved in the ordinary Chimneys with reſpect to Smoak, in the foregoing Chapter, and meet with ſeveral new Conveniencies.

For 1°. The Corners *c b a C B A* are taken off, where the Smoak uſually dilated it ſelf, and from whence it ſo eaſily found means to come back into the Chamber. *Figure* 2. 6, 15, & 17.

2°. By this rounding of the Corners, the Smoak always gets above the Fire which puſhes it underneath, and cauſes it to riſe in the Chimney, to go out of it forcibly, and by that means more readily to ſurmount the Air it meets with at its Exit, and even to hinder it from ent'ring the Funnel.

3°. The Air which paſſes out of the Chamber into the Chimney along the Parabolical Jambs, beats back the Smoak to the middle of the Fire, and above it, from whence, (as we have juſt now obſerv'd) it is violently puſh'd upwards, all at once, into the Tunnel.

4°. If any parts of the Air that ſtrikes upon the Jambs be reflected back, they all proceed to the *Focus*'s *F f* of the *Parabola*'s, and conſequently throw back the Smoak there, from whence it is again repell'd upwards by the Heat and Action of the Fire.

5°. The Air of the Room as it enters the Chimney, finding the Aperture of the Jambs more ſtraight, augments its Force ſo much the more, as the Heat in rarifying it contributes thereto; for it cannot ſpread it ſelf on any ſide, when the undermoſt Plane *o i m* of the Concave, or of the whole Breaſt is Parallel to the Horizon: So that it ſtill more reſiſts the Smoak which has a tendency to go out, and hinders it from paſſing into the Chamber; beſides that the Force of the Smoak abates proportionably as it comes near the Mantle-piece, becauſe it finds more ſpace to extend it ſelf in. *Figure* 3. *Figure* 2, 6.

6°. The Air that thus goes from the Room into the Chimney, encrea-

encreaſing its Force and Elaſticity more and more, till it has paſs'd the under part *o i m* of the Concave, when it flyes off in *m*, enters the Funnel *m L R* with Impetuoſity, and as it riſes, makes a ſort of Wind, which alſo aſſiſts the Smoak in its getting upwards, and even conſtrains it ſo to do.

Figure 3, & 31. As for the Horizontal Situation of the lower Plane of the Concave, beſides that it keeps the Air cloſe pent up, and by that means augments its Force in repelling the Smoak; it alſo ſerves to fill up the void Space *o M R* of the Breaſt, which contributed to the ſmoaking of the whole Chimney: And farther, if any Smoak flyes off and advances underneath, before it comes from *m* to *o*, it is repell'd by the Air that enters, and the Force of which encreaſes as it ſets forward to the Ground-plot of the Chimney, (as we have before hinted); and this Force is always greater near *m i o* than lower: Becauſe the Air being already warm, and that warm Surface heating it more, it has a tendency to riſe upwards, and ſtrongly preſſes on the ſaid Plane *m i o*; and ſo puts the Smoak out of a Capacity of running along in order to paſs into the Chamber.

The Cuſtom of making very large Concaves in Chimneys has oblig'd the Workmen to form the lower Part of them near upon proportionable, as we require it to be done; and theſe Reaſons ought to induce us to cauſe it to be made altogether Parallel to the Horizon.

Laſtly, if the * Band of the Funnel were made bowing in Form of a Curve; for Example, an Arch or Portion of the Circle *B e H*, the Center of which is taken on the ſide of the Concave, prolonged as at *C*, the Inconvenience of the ordinary Band *B E L H* will be avoided.

* *Languette. Figure* 4.

For 1°. The Smoak *D E* that would have ſtruck againſt *E*, will only ſtrike on *e*, and with leſs Force, as well becauſe it has not really ſo much Strength in that Place, being more remote from the Fire, as upon account that its Surface is leſs inclined: Suppoſe then, that this Smoak ſtriking againſt *E*, deſcends to *D*, from whence it would repaſs into the Chamber; in ſtriking forthwith into *e*, it will only go down to *E*, and conſequently not iſſue out of the Chimney below, but be beat back above by the Air, and the new Smoak that are continually ent'ring.

The other Band *b p h* may be left after the ordinary Manner, but it would be more expedient to make it likewiſe Curvilineal, as is repreſented in the Figure.

If theſe Diſpoſitions be not ſufficient to hinder the ſmoaking of Chimneys, it is evident at leaſt, that both contribute thereto

thereto as much as is poſſible; the others will be laid down in the two enſuing Parts of this Book.

CHAP. IV.

Of the Effect of the Vent-hole, and of the laying of the Wood proper for contributing to hinder the Annoyance of Smoak.

Figure 3, & 6. THE Vent-hole mention'd in the Fourth Chapter of the Firſt Part of Book I. does likewiſe contribute to remedy the Inconvenience of Smoak. However, this is not effected (as many Perſons fancy at firſt) by driving the Smoak upwards in the Funnel of the Chimney; for if it puſhes it, 'tis only towards the Hearth or Back: But it ſo falls out, becauſe the ſaid Vent-hole is capable of kindling the Fuel when it ſmoaks too much, and of making it continually flame (if it be thought fit) ſo as by that means to diminiſh the Smoak; and farther, by reaſon that the Vent-hole is alſo in a Capacity to augment the Heat of the Fire, which for that time will puſh the Smoak more briskly upwards, and ſo contribute to hinder its getting into the Chamber.

But for that purpoſe the Vent-hole ought to be of a middle-ſize, neither too big nor too little: Indeed all thoſe I have ſeen were ſo long, that they blew as much the Smoak of the Fire-brands, as the Fire it ſelf, and caus'd a great deal more Smoak to reflect than Heat. We ſhall therefore ſhew in the third Book the manner after which this Vent-hole is to be made, and the particular Dimenſions it ought to have.

The proper laying of Wood on the Fire may likewiſe often hinder the Smoak from ent'ring the Room. When the Wood is round, it is ſufficient to uſe Precautions, that it may have Air enough to burn without making a great deal of Smoak, and that it be as near as is poſſible to the bottom of the Chimney: But when the Wood is cleft or cut into Quarters, care muſt be taken, that the flat ſide (if it be fore) do not incline towards the Chamber, but that it be ſet either perpendicular, or even inclined towards the Ground-plot of the Chimney; becauſe the Smoak that breaks out and riſes along the flat and inclined Surface of the Wood, takes the Direction which that Inclination gives it, and eaſily paſſes into the Room, when the flat Surface of the Wood inclines on that ſide.

PART. II.

Of the Interiour Diſpoſition of the back-part of Chimneys, to hinder the troubleſome Courſe of Smoak.

IN the firſt Part of this Book we have laid down ſuch Diſpoſitions as are proper for the fore-part of a Chimney, which may all contribute towards dimiſhing the Annoyance of Smoak: But they are not of themſelves ſufficient abſolutely to hinder the ſmoaking of Parts that are very much cloſed up, eſpecially when they are but of a ſmall Compaſs; ſince thoſe Meaſures when obſerved are not effectual for taking away the internal Cauſe of Smoak.

But if we add the Interiour Diſpoſition of the back-part of the Chimney, that has been already mention'd in the ſecond Chapter of the ſecond Part of the firſt Book, the different Conſtructions of which are to be given in the third Book; we ſhall have proper Means entirely to remove that general Cauſe of Smoak; as will appear in the enſuing Chapters.

CHAP. I.

That the Exteriour Air, which paſſing thro' the Cavities of the Chimney into the Chamber, gives Heat thereto, does alſo prevent Smoaking.

WE have ſhewn in the firſt Chapter of the firſt Part of the ſecond Book, That the Fire on the Hearth cauſes part of the Air in the Chamber continually to iſſue forth thro' the Chimney; and that the moſt general Cauſe of Smoak proceeds from hence, that the Air does not come into the Room proportionably, and in the ſame quantity as it goes out. If then an Exteriour Air be ſuffer'd to enter without Intermiſſion, which paſſes thro' the Cavities of the Chimney, ſuch as have been deſcrib'd in the ſecond Chapter of the ſecond Part of the firſt Book; ſome of it will always ſucceed that which flies out thro' the Chimney.

By this Means giving all the Conduits thro' which the Air is to paſs, a ſufficient Aperture, to the end that as much may come into the Room as goes out; it will be ever full enough ſo as not to ſuffer the Smoak to enter, but to repel and make it riſe up in the Chimney, provided the Wind does not occaſion too great an

Obſtacle at the top: (the means of removing thoſe Obſtacles ſhall be hereafter propos'd) And thus the internal Cauſe of Smoak will be abſolutely taken away, which is the moſt general, and the only one that cauſes the ſmoaking of thoſe Parts which are not too much commanded.

If the Buſineſs in hand (perhaps it may be ſaid) be only to introduce freſh Air, there's no need of making ſo great a Myſtery on't; it is but opening a Door or a Window, and too much will frequently come in: It is true; nevertheleſs the Matter in debate is not ſimply about bringing in freſh Air, but to cauſe ſuch freſh Air continually to enter, as is capable of heating the Chamber, and preventing the Smoak; and by opening a Door or a Window, the Room would be certainly cool'd, and the ſmoaking not always remedy'd: Nay, that Annoyance would be even ſometimes encreas'd;, when for Inſtance, they are on a ſide oppoſite to that from whence the Wind blows: For the Smoak will during that time iſſue out thro' thoſe Apertures, (as we have already obſerv'd in the firſt Chapter of the firſt Part of this Book) and fill the whole Chamber.

But the Air that comes in after having paſs'd thro' the Cavities of the Chimney, when there is a Fire, inceſſantly gives Heat to the Room, with the other Conveniences ſet forth in the firſt Book, and extinguiſhes the Internal Cauſe of Smoak; by reaſon that on which ſide ſoever the Wind riſes, it always enters the Chamber, as ſoon as any Fire is made in the Chimney, as we have explain'd the Matter in the third Chapter of the ſecond Part, and in the fourth Chapter of the firſt Part of the firſt Book.

And indeed, this Air enters quicker, and by Conſequence in a greater Quantity, when a Wind is ſtirring, eſpecially if it comes on the ſide of the Aperture, and blows into it; but be the Weather ever ſo calm, there always comes in Air enough to hinder the irregular Courſe of the Smoak, provided the In-let and the Conduits have a certain Aperture proportionable to that of the Funnel of the Chimney, and to the quantity of Fire on the Hearth: For a leſs Courſe of freſh Air is requiſite, when the Weather is ſtill, to puſh the Smoak; by reaſon that finding a more free Paſſage above, it has leſs need of being preſs'd by the Air of the Chamber, in order to conſtrain it to enter the Chimney, to riſe up there, and to go out at the top. A leſs Quantity of this freſh Air is alſo only needful when the Funnel is ſtraight, and leſs Fire kindled; becauſe in both thoſe Caſes, there iſſues forth a leſs Quantity of the Air that is in the Room.

CHAP.

CHAP. II.

Of the Size of the Aperture of the Sides and Cavities of the Chimney, that is requiſite for introducing a ſufficient Quantity of Air, to prevent the Inconvenience of Smoak.

WHEN Air is only required to give Heat to the Chamber, leſs regard is to be had to the Dimenſion of the Places thro' which it paſſes before its Ent'rance, and thro' which it enters therein; becauſe they recede ſomewhat from the juſt Proportion they ought to have, in order to produce the whole Effect that may be wiſh'd for: It only follows, that the Room grows hot leſs ſpeedily; but the Caſe is not the ſame, when the Buſineſs in hand is to avoid the Smoak: A too large Size indeed would not be prejudicial to thoſe Places, and would only hinder the Room from growing warm, or from attaining ſo quick to the ſame Degree of Heat; but too ſmall a Size would render them uſeleſs, by reaſon that they could not furniſh a ſufficient Quantity of Air to divert the Smoak: For it is abſolutely Neceſſary that as much come in as goes out, to the end it may always ſufficiently preſs the Smoak, which otherwiſe would get into the Chamber.

But to cauſe as much Air to enter the ſaid Receptacles, as can iſſue out of them, it muſt not be imagin'd, that its In-let ought to be as large as the Aperture of the Funnel or Shaft of the Chimney is, thro' which it goes out: For tho' a greater Quantity of Air is capable of paſſing thro' that Funnel, than thro' the Aperture of Communication *B*; nevertheleſs as much may get into the Chamber thro' the latter, as goes out thro' the former; becauſe it may, and actually does enter quicker thro' one, than it iſſues forth thro' the other: And if it be, for Example, fifteen times more quick, 'tis ſufficient that the Aperture *R* be a fifteenth Part of that of the Funnel, nay it ought in that caſe to be leſs; for there does not paſs as much Air out of the Room thro' the Funnel of the Chimney, as it can hold. *Fig.* 6. 17, 24.

And farther, the Smoak as well as the Air that iſſue forth, make themſelves a Paſſage in the Air which is in the Funnel, only by expelling a part of it, and the more Air goes out of the Chamber, the more gets in again thro' the Aperture of Communication *R*; by reaſon that the more the ſaid Chamber empties, ſo much the leſs Reſiſtance the Exteriour Air meets with upon its Entrance therein; and after this manner, the quicker it paſſes, by Conſequence the greater Quantity

comes in. It is not neceſſary therefore to leave this Aperture *R* any thing near ſo large as the Funnel of the Chimney, in order to prevent its ſmoaking.

If other ſenſible Inſtances were requir'd to prove what has been juſt now ſaid, That as great a Quantity of Air is capable of ent'ring thro' the Aperture of Communication *R* at the ſame time, as that which goes out thro' the Aperture of the Tunnel, tho' the latter were larger than the former, let it be conſider'd.

1°. That there paſſes in the ſame Inſtant as much Water under the Arches of a Bridge, as in the whole Channel of the River, tho' the ſpace of that Channel be a third part greater than that of all the Arches taken together.

2°. That more Water runs out of a Veſſel thro' the ſame Aperture in the firſt Quarter of an Hour, than during the ſecond.

3°. That if the Aperture of that Veſſel were made larger in the ſecond Quarter of an Hour, yet a leſs Quantity of Water might even iſſue out than during the firſt, and the ſame thing happens in all theſe Caſes, and others of the like Nature; becauſe the Water undergoes a greater Preſſure, and runs faſter in one Place, or at one Time than it does in another.

Now the Exteriour Air always preſſes to a greater degree that which comes into the Cavities of the Chimney, than the Air of the Chamber does that which goes out of them; by reaſon that this Air which enters the Room, taking the place of that which iſſues forth, it there meets with ſo much the leſs Reſiſtance, as that of the Room leaves it more ſpace, or ſlips out in a greater Quantity.

In the third Book, we ſhall ſhew the exact Proportions that thoſe Apertures and Conduits ought to have, according to the Dimenſion of the Chambers and Chimneys.

CHAP. III.

That the Exteriour Air which paſſes into the Chamber, and beats back the Smoak, does not hinder the Rays of Heat from ent'ring therein.

IF the Particles of the Rays of Heat were like thoſe of Smoak, the ſame Air that hinders the latter from getting into the Room, would alſo obſtruct the Paſſage of the former: But Smoak being ſcarce any thing elſe than the Moiſture of Wood reduc'd into Vapours by Heat; and the Rays of Heat being compos'd even of the Parts of the Wood it ſelf, and ſo having a greater Degree of Solidity, Celerity, and Force, and leſs *Superficies* and Extent than thoſe of the Smoak; its Rays are capable of paſſing thro' the

the Air, eſpecially when it is ſomewhat rarify'd, tho' the ſame Air repels the Smoak.

Thus we ſee that the Wind which hinders Sounds from ſpreading on the ſide from whence they riſe, yet leaves a free Paſſage to the Light: Becauſe Sound diſcovers it ſelf by the Motion of the Air alone, and Light by the Motion, whatever it be, of a more ſubtil and more ſolid Matter diffuſed in the Air, which eaſily paſſes thro' its Pores, or at leaſt enters its Parts; as the Rays of Heat in like manner do, which are continually puſh'd by the Fire, even juſt ſo as the Rays of Light are by the Luminous Body: Nay, part of theſe Rays of Heat may even paſs thro' moſt ſolid Bodies; as thro' Silver, Copper, Iron, *&c.*

CHAP. IV.

Of certain Means formerly invented for the inſide of Chimneys, in order to redreſs the Grievance of Smoak.

IN the firſt and ſecond Parts of this ſecond Book, a particular Account has been given of the Diſpoſitions that we judg'd neceſſary to be uſed in the fore-part and back-part of Chimneys to prevent their Smoaking. Now to the end all Perſons may more clearly apprehend the Advantage reſulting from the Inventions that we have propos'd, and ſo avoid the Charge of putting uſeleſs ones in Execution; we are about to inſert here ſome of thoſe Means which have been long ago devis'd and practis'd, for the inſide of Chimneys to the ſame Purpoſe; and in the third Book we ſhall alſo ſet down others that have been contriv'd for the out-ſide; annexing ſome proper Reflections upon both ſorts.

1°. *Hieronymus Cardanus* propoſes Vent-holes, *i. e.* certain Tubes or Pipes thro' which the Exteriour Air is convey'd into the Chimney, in order to drive back the Smoak upwards; that noted Author alſo explains the Manner of placing them to the beſt Advantage, but theſe Vent-holes do not produce the deſired Effect: For they only give blaſts in the Chimney, and it is requiſite that the Air, or the Wind which enters, ſhould puſh the Smoak from before the fore-part of the Aperture of the Chimney, to hinder it from getting into the Chamber; and that it ſhould alſo fill the kind of *Vacuum* left by the Air which iſſues out thro' the ſaid Chimney. However, the Vent-holes are not only incapable of performing all this, but they may even occaſion a greater Smoaking; ſince filling the Chimney with cold Air brought from without, and more preſs'd than that which it expels, the Smoak finds

finds the Paſſage leſs free for its breaking forth, and ſo turns back into the Room.

Beſides, that this agitated Air or Wind, which paſſes thro' the Vent-holes into the Chimney, loſing part of its Motion as it goes farther from the Vent-hole, and dilates it ſelf; it comes to have leſs Motion than the Smoak, before it can get out: So that a Body is form'd above it which reſiſts its Efforts, hinders it from iſſuing forth, and conſequently cauſes that which ſucceeds it to paſs again into the Chamber. It is more expedient therefore rather to take away ſome of the Air that is in the Chimney, than to let in any, eſpecially a freſh cold Air, in order to prevent its Smoaking; provided a little could alſo be taken away above the Chimney on the out-ſide.

2°. Some Perſons inſtead of Vent-holes have ſet a *Tube* or *Cylinder* Horizontally along the * Draught or Breaſt of the Chimney on the in-ſide, open in its length, to let out the Exteriour Air, in the whole breadth of the Chimney: Others alſo have diſpos'd of the ſaid Tube after ſuch a manner, that in turning it; they might enlarge or ſtraighten the Aperture, ſo as to let out a greater or leſſer Quantity of Air. But theſe *Cylinders* produce the ſame effect, and are attended with the ſame Inconveniences, as the Vent-holes.

* *Hotte.*

3°. M. *John Bernard* has invented certain little *Wind-mills*, which are to be apply'd in the Draught of the Chimney, to the end that the Smoak making them turn about, they may drive it up: But if theſe Mills puſh forward the Smoak with one of their Wings or Sails, they beat it back with the other, and cauſe it to go down, and repaſs into the Chamber; neither is it requiſite to begin to puſh the Smoak in the Draught of the Chimney, it muſt be done firſt within the Room; beſides that theſe Mills would even hinder the Smoak from riſing upwards.

4°. Monſ. *De'orme* propoſes *Vitruvius*'s *Ælopyles* fixt in the Chimney, and takes upon him by that Means to remedy the Inconvenience of Smoak in Chambers of a ſmall Extent, in which reſpect he is miſtaken, and even contradicts himſelf: For *little Rooms* (ſays he, in Chap. 7.) *Smoak becauſe the Wind cannot paſs into them*; now it is evident that none gets in by the help of thoſe *Æolopyles*, and therefore they do not prevent their Smoaking.

But farther, theſe Devices could only have the effect of Vent-holes, which would be alſo leſs ſenſible, and more inconvenient, as not being continual, and in regard that the *Æolopyles* muſt be chang'd from time to time; neither is their Operation expeditious, ſince it is requiſite for them to be heated before they

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are apply'd: And laſtly, they cannot take away the External Cauſe of Smoak, nor even the Internal; ſince they don't make any Wind, nor introduce any Air into the Chamber, that is capable of repelling the Smoak from the entrance of the Chimney, and of ſucceeding that which goes out with the Smoak; a Quality which nevertheleſs is abſolutely neceſſary to hinder Places that are very cloſe from Smoaking, eſpecially when they are but of a ſmall Dimenſion; as we have already ſhewn in the firſt Chapter of the firſt Part.

5°. The above-mention'd M. *Delorme* ſays further, That the bottom of a Chimney-Funnel ought to be very large, and that the ſmalneſs of its Aperture in that Part, is one of the cauſes of Smoak. However, we have already made it appear in the ſecond and third Chapters of the firſt Part, That the exceſſive Largeneſs of the Funnel at bottom contributes to occaſion Smoaking; and that it ought to be made almoſt as ſtraight in the lower Part, as in all the reſt of its Courſe: But it is requiſite that from the Entrance to a certain Height at leaſt; the * Iron-Bands of the Sides be proportionably as far diſtant from each other, as the Jambs of the Chimney are, to the end that in riſing upwards it may not meet with any Obſtacle there in its Paſſage, which is capable of cauſing it to reflect.

* *Languettes.*

6°. M. *Delorme* alſo undertakes to hinder the Wind from lodging in Chimneys by making a Band or Partition in the midſt of the Tunnel, which takes riſe from the Draught, and reaches about a Foot on the out-ſide of it. This Means would be altogether ineffectual againſt the Winds that blow from top to bottom, and ſometimes would not be at all, or but very little ſerviceable, with reſpect to thoſe that give their Blaſts Horizontally; as he himſelf acknowledges. And indeed, the Aperture would only be too large to afford a proper Paſſage for the Wind when it blows Vertically, or when the Chimney is commanded: I have ſeen it lodg'd in a round Funnel of 3 or 4 Inches Diameter, ſo as to blow the Embers of a Stove into the Room, when it was open, and fill it with Smoak when it was ſhut.

Again, this Contrivance has its peculiar Diſadvantages: For if the Tunnel of a Chimney only has its ordinary Aperture, as we are at preſent oblig'd to give it in all Buildings that have ſeveral Stories, there would be no longer any Paſſage to ſweep it, and yet a neceſſity of doing it oft'ner; otherwiſe, the Soot partly ſtopping thoſe Conduits, would contribute to its Smoaking more, and that part of the Band which reach'd beyond, catching the Wind, would raiſe Smoak again, when the Wind happens to ſtrike againſt it.

7°. The

7°. The ſame Author gives us another Propoſal, to work the Inſide of Chimneys indented or jagged like the Teeth of a Saw, as he has done in the Caſtle of *Boulogne*, " To retain *(ſays he)* " and repell the Smoak when it is " about to go down; " but this Expedient is very fruitleſs: For it ſuffices as well for the Smoak as the Wind, that there be an Out-let thro' which they may paſs; *(qua data porta ruunt)* Neither is it neceſſary, that the Smoak lodg'd in the Funnel of a Chimney ſhould go down again in order to cauſe its Smoaking; 'tis ſufficient that it does not riſe upwards, or even that it does not riſe ſo faſt as that which follows it, and that ſome Exteriour Cauſe hinders it from iſſuing out very quick; ſince then, the new Smoak made by the Fire will abſolutely turn its Courſe back into the Chamber.

8°. Laſtly, ſome Perſons have thought fit to diminiſh the Aperture of the Chimney above the * Draught, by making as it were a *Second Draught* of a leſs extent, or a kind of *Tunnel*; hoping by that means to remedy the Inconvenience of Smoaking; becauſe, ſay ſome, (for all do not alledge the ſame Reaſon) the Funnel being in part cloſed up on both ſides of its Length, when the Smoak or Wind is about to go down, each meets with Reſiſtance, and ſo is reflected back above; and when the Fire is vehement, it eaſily forces back that reflected Smoak, ſo as to make it riſe higher and iſſue out at the top of the Chimney. It might alſo be added, That a leſs Quantity of Air from the Chamber, going thro' that diminiſhed Aperture, than it did thro' the whole Chimney, conſidering the little that enters thro' the Chinks of the Doors and Windows, this might be ſufficient to compenſate for that which is gone out; ſo that the Room being always full, the Smoak would be continually preſs'd on that ſide, and conſequently would not paſs into it.

* *Hotte.*

But beſides that this is not yet ſufficient, when the Winds lodge themſelves in the Chimney, or when the Smoak finds too much oppoſition in its iſſuing out at the top of the Funnel, occaſioned by one of the Cauſes we have produc'd in the ſecond Chapter of the firſt Part of this Book: If that part of the Aperture of the Funnel, near the Draught, which is cloſed up, cauſes the Smoak to reflect above, and to riſe upwards in the ſame Funnel; for the ſame reaſon it muſt conſtrain that which goes from the Fire to reflect below and enter the Chamber.

To avoid therefore this Inconvenience, we have advis'd, that the Funnel of the Chimney be made as large as the Breadth of the Chimney it ſelf: Since that Diminution of the Draught does not

not in any wiſe hinder the Smoak or Wind from ent'ring the Room, when it is lodg'd in the top of the Funnel: And indeed, I have ſeen it puſh the Wood-Coals and Embers into the Chamber, out of a Chimney the Draught of which was ſo made in form of a Tunnel; tho' there was alſo on the top a Device call'd *Carmelites*, and the Chimney was not commanded; and the ſame Inconvenience very often befell another Chimney, which Smoaks leſs when the Weather is calm, but ſtill Smoaks at all times, and from what Point of the Compaſs ſoever the Wind blows.

Many other Methods have been found out for adjuſting the in-ſides of Chimneys; but a judgment may be paſs'd of their Effects, by the Reflections we have juſt now made upon thoſe that are here particularly explain'd.

PART. III.

Of the Exteriour Diſpoſition of the top of the Funnel of Chimneys, proper to prevent their Smoaking.

THE Inſtructions that have been given in the two firſt Parts of this Book, may be ſufficient to hinder moſt part of Chambers from Smoaking, be they ever ſo cloſe: But there are ſome Funnels of Chimneys ſo much expos'd and commanded, that it is abſolutely neceſſary to change the Exteriour Diſpoſition of their Aperture; if one would have the Smoak go out of them eaſily, and that certain Winds ſhould not lodge themſelves therein, and force back that troubleſome Vapour.

All that has been hitherto thought of, and every thing that can be devis'd for the future to better purpoſe, for the Exteriour Part of Chimney-Funnels, in order to produce theſe two Effects laſt mention'd, can never remove the Internal Cauſe of Smoak, nor conſequently be ſufficient to remedy the ſmoaking of all ſorts of Chimneys, when the Rooms are very cloſe; unleſs at the ſame time ſuch Means are made uſe of as have been already explain'd, eſpecially that in the firſt Chapter of the ſecond Part of this Book: So that thoſe we are about to lay down in the following Chapters are not to be put in Execution alone, but added to the preceding accordingly as it is requiſite, and Occaſion may ſerve.

CHAP. I.

Of certain Conduits or Trunked Pyramids, that may be added to the Exteriour Aperture of the Funnels of Chimneys, to facilitate the going out of the Smoak from thence, and to hinder the Winds from ent'ring therein.

FOraſmuch as every thing that overlooks Chimneys, renders them liable to Smoaking, for the Reaſons that have been given in the firſt Chapter of the firſt Part of this Book; 'tis requiſite, as much as is poſſible to raiſe them high enough, to the end they may not be commanded, or that they may always be higher at leaſt than the Ridges or Tops of the Houſes.

Figure 32. And ſince the Length *A a* of the out-let of the Shafts of Chimneys, does likewiſe give the Winds an occaſion to get into them, and force back the Smoak, as has been alſo taken notice of in the ſame Chapter; it is expedient to divide that Part into ſeveral ſmall Squares, all the Apertures of which taken together are to equal the ſingle one that is given the Funnels at the top; and then the Wind will no longer meet with ſo free a Paſſage, on what ſide ſoever it comes, and when it blows in a Direction parallel to the length of that Aperture, it cannot enter therein with leſs Difficulty, than when it ſtrikes perpendicularly upon the ſaid Aperture.

But becauſe the Partitions of thoſe Squares would not ſufficiently break the Wind, and the upper part of the Funnel has a flat Surface, upon which the Air bearing in its Paſſage, when agitated, may be preſs'd cloſe, and take Occaſion from that Compreſſion, which would augment its Elaſtick Force, to enter thro' the Apertures, where it undergoes a leſs Degree of Preſſure; it is neceſſary to add above, as many ſquare concave and trunked Pyramids, *Fig.* 32. whoſe *Baſes* are longer, and Outlets at the top leſs than the ſquare Apertures of the Funnel; and theſe Pyramids, which are ſeparated one from another at the top, tho' contiguous at bottom, will hinder the Wind from getting into the Chimney, on what ſide ſoever it blows, and leave a free Paſſage for the Smoak to iſſue out.

1°. Becauſe they'll cut, cleave, and divide the Wind, and by that means diminiſh its Force.

2°. Upon account of their not having an Horizontal flat Surface, the Air will not be preſs'd, nor encreaſe its Elaſticity, as it does over the Funnels, where it meets with Reſiſtance.

3°. By reaſon that the Air or Wind, on what ſide ſoever it comes, cannot ſcour or run thro' the whole length of thoſe Funnels,

nels, nor find an eaſy Paſſage into them; ſince the Ent'rance at the top is in all reſpects very Narrow.

4°. In regard that if any Wind ſhould actually get in, every Pyramid being larger at bottom than at top, the Force of that Wind would diminiſh as it goes down, and the Aperture of the Square of the Chimney being leſſer than the *Baſis* of the concave Pyramid that covers it; the greater part of the Wind would meet with oppoſition, and be reflected back upwards; and that part of it which might paſs into the Chimney, and the Force whereof was already abated, would loſe almoſt all that was left, in ent'ring and ſpreading it ſelf about: The Smoak then by conſequence might eaſily repell that Air, being it ſelf puſh'd forward by the Air which is continually coming into the Chamber; for we always ſuppoſe with this Expedient, thoſe that have been before deliver'd, to take place.

5°. Becauſe the Wind never equally enters thro' all thoſe Pyramids, (in caſe any ſhould get in) eſpecially if the Aperture at the top of every one of them be likewiſe divided into two Parts by a ſmall Band or Partition in different Points: So that the Smoak which inceſſantly preſſes downwards does alſo always find a Paſſage to go out at, and to expel thro' one Aperture, the Wind that gets in at another.

Theſe Pyramids appear to vary but little from the Funnels that are ſeen in a great Number of Chimneys; yet it may be diſcover'd from what has been but now ſaid, That the Effect they produce is different.

That which gave me an Opportunity to obſerve, That the Aperture along the Funnels of Chimneys, ſometimes contributed to their Smoaking, is the Annoyance I perceiv'd alternatively in two Chambers of the ſame Apartment, that never ſmoak'd with the ſame Wind, at leaſt to ſo high a pitch. I took notice at firſt, that the Situations of the Aperture of the Funnels were perpendicular one to the other, and differ'd a Quadrant: I ſuſpected then, and ſoon after found out, that the Wind which blow'd in a Direction parallel to the length of the Aperture of the Chimney, run along it, and eaſily enter'd on the in-ſide in paſſing above it, eſpecially when its Direction was inclined to the *Horizon*, but that it did not meet with that free ent'rance into the Funnel, the length of whoſe Aperture was perpendicular thereto: And that therefore the ſame Wind muſt not equally occaſion the Smoaking of the two Chimneys: And that in giving each the ſame Diſpoſition of Aperture, with reſpect to all the Winds they had about them, and in reference to that which might ſtrike perpendicularly upon the Length of

the Aperture of their Funnels, the Wind would no longer lodge it ſelf therein: That is to ſay, this may be effected, by dividing that Length into ſeveral Squares, every ſide of which ſhould be near upon equal to the Breadth of the whole Aperture.

To thoſe Squares I caus'd theſe Trunked or Curtail'd Pyramids to be added, and from that time, my Rooms never ſmoak'd a Moment, as long as freſh Air continually enter'd therein; it is true that the Houſe is high, and that there is none, at leaſt in the Neighbourhood, of a greater Height: So that perhaps theſe Inſtructions may not be ſufficient for ſome Chimneys; and in that caſe, it is expedient to add a kind of *Capital*, which we are about to deſcribe in the enſuing Chapter.

CHAP. II.

*Of the Capital * that may be added to the above-mention'd Pyramids; in order to hinder the Winds from ent'ring Chimneys, that are either commanded, or too much expos'd.*

THE Pyramids but now mention'd, only conſtitute a part of the Machine that has been contriv'd to hinder the Winds from getting into Chimneys, and to repel Smoak from thence: But being diſpos'd to make tryal whether they might ſuffice alone (as was imagin'd) for Chimneys that are not commanded; and Experience having made it appear, that they had all the Effect that could be expected for thoſe on which they were plac'd, we did not judge it neceſſary to add the reſt.

But thoſe Perſons who find that theſe Pyramids are not ſufficiently effectual for ſtopping the Courſe of the Winds about other Chimneys, upon any account whatſoever; they may add above, a Triangular Priſm *S R Q q r s* either *Fig.* 33. ſolid or hollow on the inſide (if they pleaſe) of the ſame Length as that of the Aperture of the Chimney-Funnel, bearing with one of its Angles *R r* upon the middle of the three Apertures of the Pyramids; every one of which it will divide into two Parts, and whoſe Plane *S Q q s* oppoſite to that Angle will be parallel to thoſe Apertures, or laid Horizontally, and of the ſame Breadth with every one of the ſaid Apertures, to the end nothing at all may enter, which falls perpendicularly upon that Surface *S Q q s*.

* *The ſecond Chapter of the ſecond Part of the third Book, will eaſily explain any Difficulty that may be met with in apprehending what is herein contain'd.*

Above

Above this Priſm is alſo to be added a Capital open at the top, the Length of which is equal to that of the Priſm, and divided into ſeveral other ſmall ſquare and trunked Pyramids, whoſe Planes *I H G g h i*, *N O P p o n*, under the ſmall Pyramids are ſufficiently open at bottom to leave a Space on each ſide of the Horizontal Plane of the Priſm, and long enough to reach down below its Angle *R r*, which bears on the firſt Pyramids, and to cover a part of them without coming ſo near as to touch them. I affirm then that this Capital will abſolutely hinder the Winds from getting into the Chimney, whatever Situation it may have, and on what ſide ſoever they may blow; and that it will leave a free Out-let for the Smoak.

Fig. 36.

For 1°. The Smoak in its Paſſage will only meet with certain inclined Planes, along which it may eaſily ſlip, and ſo iſſue forth.

Fig. 32, 33, & 36.

2°. The Winds that come ſideways and blow Horizontally, will not get into the ſmall Pyramids on the top, for the Reaſons given in the foregoing Chapter, nor conſequently into thoſe underneath: And when their Directions are perpendicular to the Length of the Capital *L l*, they may be in a Capacity even to aſſiſt the Smoak in its going out at the top, by paſſing thro' the lower Apertures; where the Reſiſtance they'll meet with near the Tunnel of the Chimney, and at the bottom of the firſt Pyramids, may conſtrain them to enter: And when they blow from bottom to top, their Direction will puſh them into thoſe Apertures below the Capital, and oblige them to go out at the top, after ſuch a manner as to drive the Smoak before, and draw it along with them, and ſo forward its iſſuing out of the Chimney.

3°. The North-Winds, and all thoſe that blow from top to bottom, and may enter thro' the ſmall Pyramids of the Capital, will always find a more ready Paſſage to go out thro' the ſides *G g P p*, open at the bottom, where they'll convey Smoak along with them; than to get into the Pyramids underneath, the Apertures of which are cover'd by the Horizontal Plane of the Triangular Priſm: The ſame thing will befall ſuch Winds as augment the Elaſtick Force of the Air, by the Reſiſtance they meet with over againſt the Places that command thoſe Chimneys; ſo that the Winds will never find means to enter Chimneys cover'd with this kind of Capital, nor the Smoak any oppoſition or difficulty in getting out of them.

We ſhall proceed in the third Book, to ſhew all the Proportions and Dimenſions of this Machine, with the Means to put them readily in Execution.

Many

Many other Devices may alſo be contriv'd to hinder the ent'rance of the Winds into Chimneys, and to repel the Smoak; but of all thoſe that have been hitherto invented for that purpoſe, I know none that are capable of producing the deſired Effect: We ſhall therefore content our ſelves with producing ſome of them in the next Chapter, by which a Judgment may be made of the reſt.

CHAP. III.

Of certain Devices formerly apply'd to the out-ſide of Chimneys, in order to prevent their Smoaking.

1°. *Paduanus*'s *Weather-cocks*, and little *Drums*, have been for a long time us'd for this purpoſe (the latter made in form of Half-Kettles, or Quadrants of a Sphere) which being continually expos'd to the blowing Wind, by means of the Vane that turns them about, they hinder that Wind from ent'ring the Chimney. This Device ſometimes proves uſeful, but it can only ſerve for Chimneys that are not commanded hard by, and ſtand alone: For if ſeveral are near one to another, their Weather-cocks can not turn; and when they are ſingle, the Wind may run along the Length of the Vane before, for ſome time, and ſo ruſh in thro' the Chimney with impetuoſity: The Wind alſo that blows behind, when it is violent, being preſs'd cloſer on the ſide of the Drum, in getting clear, dilates, exerts its Elaſtick Force, and ſo enters on the in-ſide, and beats back the Smoak into the Chimney, or at leaſt obſtructs the Paſſages as it is going out.

And farther, theſe ſorts of Machines may ſtand in need of frequent repairing, and the Place where they are fixt is not for the moſt part convenient to ſet them to Work, eſpecially in the Winter, when nevertheleſs there is a greater Occaſion for them; the Noiſe they make in turning about, is alſo attended with its Inconvenience.

2°. Some Architects make uſe of *Serlio*'s Invention, which is to cover the Funnels of Chimneys in form of a *Frontiſpiece* or *Capital*, leaving Apertures on the ſides; as M. *Delorme* has done in the Caſtle of *Boulogne*.

M. *Des Cartes*, in one of his Letters, preſents us with a Device of the like nature: But when the Wind blows on the ſide of the Apertures, it will not fail to repel the Smoak, as alſo cauſe it to enter again, and lodge it ſelf in the Chimney on that ſide, and even on both, if it be commanded on the other ſide; ſo then this Capital would at moſt only remedy the Inconvenience occaſion'd by certain particular Winds. Beſides, be the Weather ever ſo calm, the Smoak that beats

beats underneath before it can go out, and meets with Reſiſtance in that Part, will continually turn back into the Chimney, and never iſſue forth with a ſufficient Freedom; which would make it Smoak, and be very far from putting a ſtop to that Annoyance.

3°. *Carmelites* are now very much in uſe: This Name is given to two ſmall ſquare Towers (or elſe they may be round) ſet over the ſides of Chimneys that are clos'd on the top; making Apertures on the ſide that paſs into thoſe Turrets which are open at top and bottom, and riſe ſomewhat above the Height of the Chimney. Theſe *Carmelites* may indeed in ſome reſpects be uſeful: For whether the Wind blows above or below the Turret, it ſeems to forward the going out of the Smoak thro' the oppoſite ſide, and to forbear getting into the Chimneys, or repelling the Smoak, upon account that it always finds a free Paſſage to iſſue out of thoſe Turrets, on what ſide ſoever it enters therein.

However, I have ſeen Chimneys of a great Height, not commanded, in which theſe Devices very often had no Effect, and were ſometimes inconvenient; becauſe the Wind when high, impetuouſly ent'ring thro' the top of the Turrets, and being preſs'd therein, hinders the Smoak from going out of the Funnel, and frequently beats it back even with Force enough to blow the Coals about the Room, as I have obſerv'd it ſeveral times.

4°. M. *Delorme* ſays, there needs no other Invention to prevent the ſmoaking of Chimneys, than to know how to raiſe and direct them after a due manner; but ſince the Winds inceſſantly turn about on all ſides, they muſt then have all ſorts of Situations, or one that changes as the Wind does: However, ſuppoſe it were ſo, and that ſuch a Situation of a Chimney might be found as would hinder its Smoaking; yet that Remedy would not be general, nay, it would be moſt frequently altogether fruitleſs: For an Architect cannot always give a Chimney what Diſpoſition he pleaſes, no more than to an entire Structure; that Point chiefly depending upon the Situation and Diſpoſition of the Places.

5°. Laſtly, it may be adviſeable to ſet on the top of the Funnel a kind of Device diſpos'd in ſuch a manner, as that the Chimney may be always cover'd on the top, and ſhut on the ſide that the Wind comes, by means of one of the two Wires that ſerve to depreſs or elevate it on the ſide where either of thoſe Diſpoſitions is requiſite.

I have made uſe of this means for a long while, and ſometimes with good Succeſs; but the Chimney muſt not be commanded, eſpecially over againſt one of the Apertures of the Device; for the Wind ſtriking upon the Obſtacle

ſtacle it meets with, will be forcibly reflected back into the Chimney, and this is the main Accident we would endeavour to avoid. The Device has alſo this Inconveniency, which I have formerly perceiv'd in Chimneys, even thoſe that ſtand by themſelves, that when the Winds turn about, or blow at the ſame time from two oppoſite Points, if it hinders the ent'ring of one, it gives a more free Paſſage to the other.

There are many other Methods devis'd for covering the top of Chimneys, to be ſeen in ſeveral Places; the good or ill Effect of which may be apprehended from what has been already ſaid on this Subject.

CHAP. IV.

Of the grievous Annoyance of Smoak, and the Neceſſity there is to avoid it.

ALL Chambers and Chimneys are not equally ſubject to Smoaking, and thoſe that are moſt liable, do not Smoak equally at all times. Sometimes the Winds beat back this Vapour, after ſuch a manner, that tho' the Weather be ever ſo exceſſive Cold, yet its Inconvenience is more tolerable than that of thoſe great Smoaks; ſo that it is abſolutely neceſſary either to quit the Apartments at that Inſtant, or to quench the Fire, and both are often very incommodious. This indeed does not happen in all Sorts of Apartments, but there are not any when they are very cloſe, that do not Smoak more or leſs; and if a warm Air be not continually introduc'd therein during the Winter, either the Cold or the Smoak muſt be altogether endur'd without any Remedy.

Among ſeveral Diſaſters that accompany this Accident, the ſharp Pains felt in the Eyes in Places that Smoak are moſt common: But thoſe Perſons who have neat Apartments, and valuable Houſehold-Goods, which they would have preſerv'd, are ſenſible of theſe Inconveniencies, and even of others, which are likewiſe dreaded by Ladies and Gentlewomen of a more tender Conſtitution, eſpecially upon account of their Linnen, Lace, Headdreſſes, Cloaths, *&c.* Beſides theſe Effects that are ſo troubleſome, and yet ſo uſual, Smoak is ſometimes attended with fatal Conſequences.

It is well known how many People have been ſuffocated with the Vapour of Coals or Charcoal, from which that of Wood only differs, with reſpect to a greater or leſſer Degree. One Day I made a ſad Experiment of the diſmal Effect it is capable of producing: I had for ſome days a Stove in my Cloſet in the Country; but the ſhort time I try'd it had

had not as yet given me an Occaſion to perceive its Inconveniences, nor to ſeek for Means to avoid them; eſpecially not having an Intention to make uſe of it much longer. One Morning the Wind lodg'd it ſelf after ſuch a manner thro' the Aperture of the Funnel on the out-ſide, that it fill'd the Room with Smoak in an Inſtant, and caus'd the Flame to break out thro' the ſmall Aperture which ſerv'd as a Vent-hole: Whereupon I immediately order'd the Wood to be taken away, and Charcoal laid in its ſtead; then the Smoak was leſs troubleſome, and even ſo little that I did not perceive it, during two or three Hours I continu'd there employ'd in Writing. When my Buſineſs was ended, I became too ſenſible of it, and went out forthwith to breath a better Air; but I was ſoon ſeiz'd with a Dizzineſs of the Head, a pain at the Stomach, and a *Nauſea* during the whole Day, which gave me ſufficiently to underſtand, that if I had ſtay'd ever ſo little longer in that Place, the Conſequences would have been much more dreadful.

By that means I apprehended how far Smoak that gets into the Stomach and Lungs is capable of occaſioning Diſorders there, tho' the Annoyance be not felt at the very firſt Moment. What then will the iſſue be, and what Effect is to be dreaded, when it is immediately ſo ſenſible, and when People dwell ſo long in Places that it continually fills? It is not to be doubted then in the leaſt, but that it is the ſource of many Diſtempers that are attributed to quite different Cauſes. We read in the Hiſtory of the Academy of Sciences, *Ann.* 1710, a very Tragical Relation upon this Subject, and a great many more are to be found elſewhere.

Thus we ſee by the Effects of Smoak which are known, and by thoſe that ought to be fear'd, that we cannot too diligently ſeek for, nor too much practiſe the Means of avoiding it.

The Concluſion of the two firſt Books.

IT may be obſerv'd as one is peruſing in this ſecond Book, the Diſpoſitions of theſe Chimneys to hinder the Annoyance of Smoak in all ſorts of Chambers, That they are the ſame with thoſe laid down in the firſt Book, in order to ſpread about and encreaſe the Heat therein; and that thoſe ſame Diſpoſitions which give a greater Degree of Heat, are alſo ſerviceable in putting a further ſtop to the Courſe of Smoak.

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The Diſpoſition of the Parabolical Jambs equally contributes to both theſe Effects; and the ſame Thing may be affirm'd with re-

ſpect to the Horizontal Situation of the lower part of the Concave, and the Vent-hole. The Air that enters from without, after having grown warm in the Cavities of the back-part of the Chimney, heats the Room to a greater Degree, after the moſt agreeable and moſt advantageous Manner, and might alone give it a ſufficient Warmth: The ſame Air, at the ſame time, takes away the moſt general Cauſe of Smoak, and may alone ſuffice to prevent the Smoaking of many Chambers: Laſtly, the Exterior Diſpoſitions on the top of the Chimney, which contribute towards augmenting Heat in the Rooms, free us from the moſt troubleſome Cauſe of Smoak, by hind'ring the Winds from getting into the Chimneys, and driving back that Vapour into their Funnels.

BOOK III.

Of the different Conſtructions of the new-invented Chimneys, and of the ſeveral Ways of putting them in Execution.

WE have only explain'd in the firſt and ſecond Books the Diſpoſitions of theſe new Chimneys, as far as was neceſſary to make the Reader apprehend their Effects, and the reaſons of thoſe Effects; but to the end that the Workmen may be capable of putting them in Execution, it is requiſite to give a more particular Account of their Conſtructions, which is the peculiar Subject of this Third Book.

PART I.

Of the Conſtructions of the Hearth and Jambs of Chimneys, and of the Cavities that are to be left behind, as well to augment the Heat, as to hinder the irregular Courſe of Smoak.

WE ſhall proceed to treat of all theſe Conſtructions in this Firſt Part; becauſe the ſame Workmen ought at the ſame time to apply themſelves to the Management of one as well as the other, at leaſt in part; and in regard that thoſe which ſerve to encreaſe the Heat, are the ſame that prevent the Annoyance of Smoak.

CHAP.

CHAP. I.

Of the Model or Size proper to give the Hearth and Jambs of Chimneys, that Sweep and Disposition they ought to have with a great deal of Ease and Exactness.

WE suppose the Aperture at the bottom of the designed Chimney to be four Foot in Length, and twenty Inches in Depth; we shall also give for other Chimneys that are of larger or lesser Dimensions, the Length of the Lines we are about to determine for this.

A Plank or Board *A B b a* is to be taken of four Foot in Length, and twenty Inches in Breadth, the Sides of which are all made equal one to another with a Mason's Square, so as to make the Draught likewise Square: Then from the Middle M of the Side B b, the Length M C of eleven Inches is to be mark'd; and from C, the Length C G of four Inches: That done, the Line G A is to be drawn, on which G H must be taken of five Inches; from the Point H, H P is to be drawn Square, or Perpendicular to G H A, the Points H C are to be joyn'd, and on the middle I of the Line H C, I P is to be drawn Perpendicular: Afterwards from the Point P, where it cuts the Line H P, as a Center, and from the distance P H, or P C, the Arch H C is to be describ'd: The same Thing should be done on the other side, where the same Letters are set in a small Character. *Fig. 7.*

Without drawing the Lines H C, I P, one may by feeling find out the Point P, in order to describe the small Arch that passes thro' the Points H and C.

Within the Space of an Inch from the side B c c b of the Board, the Rectangle K *k t* T is to be mark'd, of a Foot in Length, and eight Inches in Breadth, the middle of which is opposite to M; and within three Inches of K T, another small Rectangle Z, three Inches long, and 2 ½ broad, the middle of which answers to the middle of K T: These two Rectangles are to be voided, and the Board cut away along the Draught A H C M *c h a*; and we shall have the Model, which may be made use of to give the Curvature or Sweep of the Chimney. *Figure 7.*

We have suppos'd the Aperture or Breadth A *a* of the Chimney to be 4 Foot; if it were only 3 ½, C G would be taken but 3 ½ Inches, and three Inches if the Aperture A *a* were only three Foot wide; and G H 4 ½ Inches in the first Case, and only four Inches in the second.

In all these Cases *g h* may be made equal to *g c*, and the Square or Perpendicular drawn upon these *Figure 7.*

two Lines *c p* and *h p*; and from *p*, the Point of their Interſection as a Center, and from the Interval *p c* or *p h*, the Arch *c h* is to be deſcrib'd; and the ſame thing done on the other ſide.

If it were requir'd, that the Sides A H C *a h c*, which come near a Parabolical Line, ſhould abſolutely have the Draught of that Line, it would be an eaſy matter to give it them.

A Method for making the Sides of the Model in Parabolical Lines.

HAving cut or mark'd on a Board the Rectangle A B *b a*, four Foot long, and twenty Inches broad, with the ſmall Rectangles K k *t* T and Z, as in the preceding Figure; the Points C *c* are to be mark'd, each diſtant eleven Inches from M, in the middle of B *b*: Then the Lines C D, *c d* are to be drawn with a Square upon B *b*, which are likewiſe to fall Perpendicular upon A *a*; a Rule *r ſ* is to be laid on the Points *d b*, and above that Rule the Square *l g n*, the Angle of which *g* touches the Point *b*; and the Point *o* is to be mark'd, where the other ſide of the Square cuts the Line *d c*, prolonged as much as is needful: That done, the fourth part of the Line *c o* is to be taken, which is muſt be carry'd from *c* to *q* and *f*, and from C to Q and *F*. *Figure* 8.

Afterwards the Rule R S is to be plac'd and ſtay'd over the two Points *q* Q; a String is to be ty'd at the end of the Square N, of the Length of the ſide N G, which is at leaſt equal to Q D; and the other end of that String made up into a Loop, is to be put over a Nail or Bodkin ſtuck in F. *Figure* 8.

At firſt the ſide N G of the Square and the String are to be ſet along the Line D C, and the other ſide G L over the Rule R S: Then that Square is to be ſlipt over the Rule, removing it more and more from the Point F, and continually keeping the String ſtrain'd along N G as much as is poſſible, by ſupporting it with a Bodkin or a Crayon, the Point whereof touches the Board; and the Line which that Crayon marks, will be the Parabolical Side requir'd. The ſame Thing is to be done on the other ſide, and afterward this Board cut away along the Draught that is mark'd, in order to have the ſought for Model.

This Method is no more difficult than the foregoing, and is even more convenient in ſome Reſpects: Since it is always the ſame for all ſorts of Chimneys, and there is no need of taking new Meaſures of Lines, according to the different Dimenſions of Chimneys.

One

One might alſo (the ſame Things being ſuppoſed) carry half the Line *c o* from *c* to *x*, and from *x* as a Center, and from the Diſtance *x c*, deſcribe an Arch *c h*; then from the Point *a*, the Line A H might be drawn, which touches that Arch, without ent'ring in, and the ſame thing might be done on the other ſide; whereupon the Draught *a h c* M C H A, will be that of the Model; neither is this way of tracing it out, leſs ſimple, or leſs facil, than the two former.

CHAP. II.

The firſt Conſtruction for ſimple Chimneys.

Fig. 7, *or* 8. THE Model A H C *c h a* for the Sweep on the in-ſide of the Chimney, being drawn by one of the Methods given in the preceding Chapter, and cut off; it muſt be apply'd to the Hearth, or to the Place where the Hearth of the Chimney intended to be built, is to be fixt, after ſuch a manner that the Points *Fig.* 6. A *a* may touch the Extremities of the fore-part of the Jambs, which are to be erected along the Draught A H C *c h a*.

2°. The lower Plane of the Concave is to be made parallel to the Horizon in its Breadth, or level in that reſpect (for it might be centred or form'd Arch-wiſe) as if it were deſign'd to be ſet with a Square on the Back of the Chimney, from which it muſt be diſtant but ten or twelve Inches; *Fig.* 3, *and* 31. to the end the Funnel may only have this Breadth in that Part, as may be ſeen in the *Figures* 3 and 31.

3°. If the Tunnel be winding, the * Bands or Partition-plates of the Sides B e H, *B g H* are to be made in form of Parts of a Circle, from the top of the Jambs B and b, to the Cieling *H h*, by continuing a Line B *b c* on the Horizontal Plane of the Concave; ſo that the Point *C* of that Line, which is equi-diſtant from both the Extremities B and H of the Band may ſerve as a Center to deſcribe the Arch B e H.

* *Languetter. Figure* 24.

Theſe three Diſpoſitions of the Jambs, of the lower part of the Concave, and of the Funnel, that ought alſo to be made uſe of in all other Chimneys hereafter mention'd, form the firſt Conſtruction, which, tho' it appear but little different from that of the ordinary Chimneys, yet gives more Heat beyond Compariſon, without making a greater Fire, and even with a leſs; as has been demonſtrated in the ſecond and third Chapters of the firſt Part of the firſt Book.

We might alſo add (if it were deſir'd) an Aſh-hole *K k t* Z, and the Vent-hole *Fig.* 6.

Z, the

Z, the Construction of which shall be laid down in the tenth Chapter.

This first Construction may be executed with very little Expence, in all sorts of Chimneys, without touching the Mantle-piece, or putting any Thing out of order that is above it: But the said Construction only encreases the Heat, by reflecting a greater Quantity of it than the ordinary Chimneys do, and would not be always sufficient, as the following are, to free those Chambers from Smoak that are subject thereto, tho' it contributes towards hind'ring the Course of that troublesome Vapour, and may even be effectual enough in a great Number of Chimneys; as we have shewn in the third Chapter of the first Part of the second Book.

CHAP. III.

The second Construction for Chimneys that continually furnish fresh Air, which grows warm behind the Back of the Chimney.

THE Construction but now laid down in the foregoing Chapter, differs so little in its Execution from that of the ordinary Chimneys, that the Workmen cannot meet with any new Difficulty in this Affair; but the same Quality is not to be attributed to the Constructions we are about to explain in this and the following Chapters; To the end that the latter may be more easily apprehended and put in Execution, we shall at first describe every Piece in particular, and afterward shew how they are to be joyn'd together, and laid in their proper Position.

The first Piece then, for this second Construction, being very simple and plain, is a Plate of Copper or Iron *H I i h* made up of several Leaves or Sheets set together, and extending about four Foot in Length, and 3 ½ Foot in Height. *Fig. 9. Piece 2.*

Forasmuch as the Flame is continually to strike on the middle of this Piece at the bottom, and the Coals or Embers bear upon it, when the Fire is kindled, and since by Consequence, it may be worn out and burnt in a short time; if it be thin, 'tis expedient to add in that part a small Plate O D F I L, in form of a Back, and round about on the out-side of it a little Iron-Frame about half an Inch thick; both fasten'd to each other with Screws, the Nuts of which are fix'd behind, to the end that another Plate may be let into the same Frame, at pleasure, with the same Screws without defacing any part of the Chimney.

The other Pieces consist of small Iron-bands or Partition-plates five Inches broad, and about ten Inches lower than the Height of the great Plate, on which they are to be fasten'd on the Back-side, along the Lines H I, *C X, c x, b i,* after such a manner

manner as the firſt may begin from the top, and end ten Inches above H; the ſecond leave the ſame Space at top, that the firſt does at bottom, the third be laid as the firſt, and the fourth as the ſecond; as may be diſcern'd in Figure 18, and ſtill more conſpicuouſly in Fig. 30.

It is ſometimes expedient to put four ſuch Bands between H and *h*, but at preſent we only ſuppoſe two, in order to render the Machine more eaſy to be conceiv'd, put in Execution, and plac'd in its due Situation; ſo that after having well apprehended and executed it in this Simplicity, there will be no great Difficulty, with reſpect to the others that are more compounded.

Theſe Bands being thus fixt, the middle of the Plate of the Back M, is to be ſet over againſt the middle M of the Model A H M *c h a*; then the ſaid Plate muſt be bow'd round all along, to the end it may make the Sweep from bottom to top; and we ſhall have the ſecond Conſtruction of a Chimney, which is to be afterwards laid in the following manner.

A Method for fixing the ſecond Conſtruction of a Chimney.

BEFORE the laying of this Chimney, and the others, the Conſtructions of which ſhall be explain'd in the enſuing Chapters, an Aperture is to be made of about a Foot Square in a Wall that ſtands neareſt the Street, or faces it, or in a Court, or ſome other Place which has a Communication with it, almoſt level with the Floor at bottom, or even lower: To this Aperture a Canal is to be joyn'd (if needful) thro' which about ſixty or ſeventy ſquare Inches of Air may paſs; and the ſaid Canal muſt be fixt in the Wall, or under the Floor, or carry'd along the Wall into the Chamber, accordingly as it is judg'd moſt convenient for conveying the Exteriour Air to any Place where it is neceſſary, in order to bring it into one of the Cavities on the back-ſide of the Chimney.

If it were expedient, or more commodious, this Air may be let in thro' the top of the Tunnel, by fixing a ſmall Canal on the in-ſide, which may go down ſomewhat below the Hearth, from whence it is to turn upwards in the firſt Cavity, where-ever one would have the ſaid Air brought from without, to take its Courſe; but this muſt be contriv'd as the Chimney is building, otherwiſe it cannot be effected without greater Difficulty.

This Paſſage for the Exteriour Air being made, the Model A H C M *c h a* *Fig. 15.* is to be ſet upon the Hearth of the Chimney, or on the Place where it is deſign'd to be fixt, between

between the Jambs, or the Places where they are, if any be already erected; ſo that the fore-part *A a* will be on the ſame Line with the Mantle-piece, or the fore-part of the Jambs: Then a curved Line *A H C c h a* is to be drawn along the Model, on which the Sweep of the in-ſide of the Chimney, or the great Plate when laid, is to range: Within four Inches of this firſt Line, but only from the Places, where the laſt Bands are to anſwer, a ſecond Curve M N *m n* is to be mark'd parallel to the former, which muſt be taken partly out of the Wall of the Back, if it can be done, and if it be allow'd to dig that thickneſs, and to the Height of three Foot, or three Foot and half; otherwiſe it is requiſite at firſt to bring the Model forward, ſo as there may be left behind it four Inches over againſt the Line *C c*.

In that caſe, the Jambs are likewiſe to be ſet forward in the Chamber, as much as is needful, and even the fore-part of the Funnel of the Chimney, if there be occaſion: The Spaces A H M, *a h m*, and thoſe beyond the ſecond curved Line M N, *m n*, are to be fill'd up; nevertheleſs, without ſtopping the Canal D y, thro' which the Air is to paſs into the Cavities behind the Chimney: In the bottom and ſides, ſmall *Channels* or *Gutters*, as M N, *n m*, are to be cut, to let in the Bands which are on the back-ſide of the great Piece: Laſtly, from the Place thro' which the Air taken from without may enter behind the Chimney, a little Conduit H Z is to be made, bordering upon a Cavity form'd in the Place, which the Vent-hole Z muſt anſwer to, when the Chimney is fixt in its proper Place, that is to ſay, twelve or fifteen Inches from the Back forwards; the Conſtruction of the ſaid Vent-hole ſhall be produc'd in the tenth Chapter of this Book.

This Cavity being ſo diſpos'd, the Chimney is to be laid in ſuch a manner as to retain the Figure of the Model ſet on the in-ſide, and ſo as the Bands of the great Iron or Copper-Plate may enter the Channels made for that purpoſe, and that a Diſtance of four Inches be left between the great Plate and the Wall. The void Space of the Channels is to be fill'd up, ſo as the Air may not paſs out of one Cavity into another thro' thoſe Places; and all the other Parts thro' which the Air may get into, or iſſue out of the ſame Cavities, are to be cloſe ſtopt, except the Aperture *D* or *d* at the bottom, and the Aperture *R* or *r* which is left on the top. *Fig.* 17, 18, *&c.*

When there is any Difficulty in ordering thoſe Channels or Gutters after the Bands are enter'd, and the Chimney laid, 'tis requiſite before it is fixt, to fill them up with very ſoft Morter or Plaiſter,

ſter, to the end that the Bands in ent'ring may make their Bed, and be well ſettled therein.

This Difficulty may be avoided, and ſeveral other Conveniences obtain'd, by cloſing thoſe Bands with a ſecond Plate parallel to the firſt; for it would produce a kind of *Hollow Cheſt* or *Box*, which might be readily ſet up, faſten'd, remov'd, or carry'd from one Place to another; the manner of putting it in Execution with much Facility, will be ſhewn in the ſixth Chapter.

If the Cavity behind the Back of the Chimney be not taken in the Wall, it is expedient to nail on the top of the great Plate, a piece of Iron, which in that Part might cloſe up the Space behind, or ſerve to ſupport the Plaiſter that is laid to cloſe it.

The Chimney being thus laid and ſettled, on what ſide ſoever the Exterior Air is taken, it muſt be convey'd to *D*; thro' which it will enter, and riſe up in the firſt Cavity, go down thro' the ſecond, and get up again thro' the third; from whence it will paſs into the Chamber thro' the Aperture *r*, when there are but three Cells, as in *Figure* 18. We have before explain'd the Reaſons of this Courſe of the Air in the third Chapter of the ſecond Part of the firſt Book.

Fig. 18.

But in regard that the Air ſometimes may not grow ſufficiently warm in paſſing only thro' thoſe three Cavities; five might be made (as has been already intimated) by adding two Bands, or Partition-plates, more, and diſpoſing them all, as is ſhewn in the 20th and 30th *Figures*, and the Air will paſs thro' them, by aſcending in the firſt, third, and fifth Cells, and deſcending in the ſecond and fourth. Seven Cells might alſo be form'd, by carrying on the great Plate to the Mantle-piece, or fore-part of the Chimney; for it ſuffices that there be a Diſtance of about ten Inches between every Band for the common Chimneys; but there muſt be no leſs, in order to afford a Paſſage for about forty ſquare Inches of Air: When they only take up that ſpace, it is expedient to make the ſecond Cell ſomewhat larger than the firſt, the third larger than the ſecond, and ſo of the reſt.

The Lines that go winding about in theſe *Figures* 18, and 20, and in the others, ſenſibly ſhew the ent'rance of the Air in thoſe Cavities, its *Route* or Courſe, and its Exit.

To the end that the Air which is to paſs into all the Cavities, may only come into the Room when judg'd expedient, and that none may get in but ſuch as is wanted, it is requiſite to fix certain *Sliding-Boards* or *Doors* at the Places *R* or *r*, thro' which it is to enter, that may be open'd more or leſs, as Occaſion ſerves: It may alſo be brought into thoſe

Places hot or cold, or temperate, to any degree at Pleaſure; as will appear to thoſe that peruſe the ninth Chapter.

If any Perſons are diſpos'd to burn Wood ſet upright, as I have heard ſome ſay, it is cuſtomary in *Sweden*; they may cauſe theſe Chimneys to be rais'd in an abſolute Parabolical Figure; and they'll be of good uſe for Places where People are oblig'd to have very ſmall Chimneys, or to build them in Corners; but we do not think it neceſſary to enlarge any further upon their Conſtruction.

CHAP. IV.

The third Conſtruction, in which the freſh Air that continually enters the Chamber, acquires Heat behind the Chimney, and under the Hearth.

IN the preceding Conſtruction, the Air only grows warm behind the Back and Sides of the Chimney; but it may alſo take a great deal of Heat in paſſing under the Hearth.

In order to have the firſt Piece of this third Conſtruction, the Model (which we ſuppoſe henceforth already rounded and cut thro') is to be laid upon a Plate of Copper or Iron, ſomewhat longer and broader than it is; and a Curve A H C M *c h a A* is to be at firſt mark'd out quite round this Model, and afterwards a ſecond Parallel thereto, ¾ of an Inch diſtant from the firſt Line, as it appears pointed with ſmall Pricks in the Figure: A Draught *K k t T*, the proper Place for the Aſh-hole (if it be thought fit to have one) is to be markt in like manner, and lower, that of the Vent-hole Z; the two Places laſt mention'd are to be voided or cut thro', and the Aſh-hole ſunk an Inch. In the 10th Chapter, we ſhall give the Conſtruction of the ſmall Trap-door fixt over that Aperture Z, to ſerve as a Vent-hole. Laſtly, the Extremity which goes beyond that Line, is to be folded downwards to a Square, in order to keep the whole Work in a due Poſition when it is plac'd; and thus the firſt Piece of this Conſtruction will be abſolutely compleated.

Fig. 9. *Piece* 1.

The ſecond Piece is a Copper-plate planiſh'd or made ſmooth A B E G *g e b a* of the ſame Length as the Circumference of the Jambs, and Ground-plot of the Chimney, that is to ſay, about ſix Foot in this Draught (it may be only four Foot, and made of pieces of Iron) and of about 3 ¼ Foot in Height: The lower Part, and both ſides of this Piece are to be folded to a Square to the Breadth of from four to five *Lines*; the Heights A B, *a b*, of two Foot 8 Inches each are to be ſet off on each ſide: The two ſmall Rectangles B E G, *b e g* are to be taken away,

Fig. 9. *Piece* 2.

away, when this Plate is ſix Foot long, and covers the whole Compaſs of the in-ſide of the Chimney; and in the middle of the Piece, a ſmall Plate is to be ſet, with its Frame, as has been ſhewn in the preceding Chapter, Page 70.

Certain ſmall Plates five Inches broad, and ſome about two Foot and a half high, others above a Foot, are to be cut (as is ſeen in *Figure* 28.) to ſerve as Bands behind the ſecond Piece, and under the firſt; and thus we have all the Pieces which are to be made uſe of in building the Chimney.

To ſet all theſe together, the ſecond Piece G E B A M *a b e g* is to be turn'd upon the Model *A H C M c b a* which is held to it, after ſuch a manner that its middle *M* may anſwer to the middle *M* of the firſt Piece: Afterwards this Model is to be placed and ſtay'd on the Line A H C M *c b a* of the firſt Piece; and the ſecond Piece is to be laid on this firſt quite round about the Model, taking care that it bear every where upon the ſame, and that its Concavity be exactly anſwerable to the Convexity of the Model.

Foraſmuch as the Parts that are folded at bottom along the Line *A C M c a* only have a Breadth little above one third part of an Inch, and that which exceeds this Stroke of the Model in the firſt Piece, has a Breadth of three fourths of an Inch, there will as yet remain almoſt half an Inch of Metal exceeding the other Pieces: Theſe Parts are to be folded back again over the Curvature of the ſecond Piece, and Rivets put here and there, and the two Pieces will be firmly joynted one upon another, ſo as not to leave any Paſſage between them, either for the Air or the Smoak, which muſt be avoided with great Application: So that when theſe Pieces are made up of ſeveral Iron-plates joyn'd together, the Rivets are to be ſet very cloſe one to the other; and when they conſiſt of Copper, it would be moſt adviſeable to have them cemented with very ſtrong Solder, at leaſt thoſe that conſtitute the ſecond Piece; ſince it is a great deal more proper for them.

Laſtly, it is requiſite to fix upon a Square, behind the ſecond Piece on *Fig.* 19. each ſide of the middle *M*, two Bands, or Partition-plates, five Inches broad, of which the two neareſt to *M* are diſtant from it at leaſt five Inches, and the two others fifteen, ſo as there may be at leaſt ten Inches between each. As many Bands are to be faſten'd under the firſt Piece that conſtitutes the Hearth; which are to joyn the others at bottom in form of a Square. The firſt and the third are not to reach the Line A *a* at the extremity of the Hearth, nor the ſecond and the fourth to the top of

the ſecond Piece; they'll fall ſhort at leaſt ten Inches, as appears in *Figure* 19. If you would have the Courſe of the Air be longer, ſo as it may grow hot to a greater Degree; two Bands more may be added, in order to have five Cells, as in *Figure* 21; and even ſeven ſuch Cells might be made if it were deſir'd.

The Bands under the Hearth may be laid parallel to the Back of the Chimney, and lye from one Jamb to another; as in the *Figures* 22, 23, and 24.

The ſame Diſpoſition may be alſo given to the Bands of the Plate that makes the Sweep of the Chimney on the in-ſide, and they may be ſet Horizontal, and lying out Side-ways, as in *Figure* 22; eſpecially if one were diſpos'd to leave the Jambs parallel to each other, and the Back in a Right-line, and perpendicular to the Jambs, as in the ordinary Chimneys: But when the Chimneys have the compaſs we give them, or their Corners only rounded, it would be ſomewhat more difficult to make faſt the Bands, if they were brought round about the Corners: However, this Difficulty does not induce us, always to ſet the Bands perpendicular; for they may be only faſten'd along the ſpace of twenty two Inches, that we leave in a Right-line on the Back: But it is upon account that in the perpendicular Situation, the Air takes part of its Route in deſcending, as is apparent in the *Figures* 18, 19, 20, *&c.* and ſo paſſes with leſs Celerity, and may conſequently grow warm to a greater degree, than in the other Situation, by only tracing out the ſame Length of Courſe.

Altho' all theſe different Diſpoſitions of the Bands are equally eaſy to be apprehended, only by caſting an Eye upon the Figures; nevertheleſs the Workmen will do well to apply themſelves at firſt but to a ſingle one, as that of the laſt Chapter, which is the moſt ſimple, till they have render'd it familiar to them, and endeavour afterwards thoroughly to underſtand the manner of laying it; but before they put the Matter in Execution, it is expedient that they make or cauſe a Model to be made, which is ſufficient if it be only of Paſte-board or Card.

A Method for diſpoſing of the third Conſtruction of a Chimney.

WHEN a Paſſage is ſet out for the Exteriour Air, as has been ſhewn in the laſt Chapter, Page 71, *Fig.* 15, *&* 19. and a ſpace digg'd out in the Back-wall of the Chimney, along the Line drawn with the Model, as we have already explain'd in Page 71, 72; a Cavity four Inches deep is alſo to be made under the Hearth, and

and Channels cut to let in the Bands; and from the Place thro' which the Air brought from without, paſſes under the Hearth, a ſmall Canal H Z is to be form'd, that borders upon the Cavity, which the Vent-hole Z muſt anſwer to, when the Chimney is ſet in its proper Poſition.

Theſe Hollows in the back-part of the Chimney, and in the Hearth, being ſo diſpos'd, the Chimney is to be plac'd after the manner we have ſhewn Page 72.

When the Chimney is laid and ſettled, and the Exteriour Air convey'd to the Aperture D, it will enter the Cavities, and make the Courſe mark'd by the Lines which go winding about in the *Figures* 19, 20, 21, 22, *&c.* according to the Diſpoſitions that are given to the Bands behind the Back-part of the Chimney, and under the Hearth. *Fig* 19, 21, *&* 22.

What has been ſaid concerning the Aperture R or *r* for the preceding Conſtruction, Page 73, ought alſo to be underſtood of this we are now treating of.

CHAP. V.

The fourth Conſtruction, wherein the freſh Air continually enters the Chamber, grows warm behind the Back-part of the Chimney, under the Hearth, and under the Concave.

BEſides the Heat that the Air contracts behind the Back-part of the Chimney, and under the Hearth, it may get conſiderably more, in paſſing under the Concave, or fore-part of the Breaſt. *Fig.* 9. *Piece* 1, *&* 2.

The two firſt Pieces for this fourth Conſtruction are to be drawn, cut and ſet together, as thoſe of the foregoing Conſtruction, and after the manner explain'd in the laſt Chapter, Page 74, and *ſequ.* But it is only requiſite to ſet four Bands on the back-ſide of the ſecond Piece, diſpos'd according to the Order mark'd with the pointed Lines H I, C X, *C X*, *h i*.

To diſpoſe of the third Piece, the Model A H C *c h a* is to be laid upon a Copper, or Iron-plate B G *g b*, which goes beyond the Extremity A *a* about half an Inch: Then along H *h*, a Line B E is to be trac'd out, equal to B E of the ſecond Piece, and another *b e* equal thereto, at the other end along *a h*: From the Points *E* and *e*, two Perpendiculars E *G e g* are to be rais'd upon the Line E *e*, equal to the Lines E G, *e g* of the ſecond Piece: Afterwards a Line is to be drawn from G to *g*, and another from *B* to *b*, and this *Piece* 3.

this Piece is to be cut within half an Inch of the Stroke G E B *b e g*, and folded to a Square along the Line E *e*; that Part which exceeds the Line *B b* is likewiſe to be folded upwards, and what is left beyond the Lines G E B, *g e b*, downards.

The two firſt Pieces being ſet together, it is requiſite to make faſt on the void Spaces B E G, *b e g* of the ſecond, this third Piece; the Extremities of which B E G, *b e g* being folded back, will ſerve to nail along B E G *b e g*.

One may alſo by means of another Piece folded likewiſe to a Square (only made of Tin, or of Iron beat very thin) cloſe the fore-part, and the upper-part of this third Piece, and joyn them together with Rivets, in order to make a ſmall Canal; ſo as the fore-part and upper-part of this Canal may be afterwards more readily cover'd with Plaiſter, which would render it more ſolid, and the Air that is to paſs therein would be heated to a greater degree.

A Method for placing the fourth Conſtruction of a Chimney.

THE Cavities, or hollow Spaces, are to be made in the back-part of the Chimney, and in the Hearth, as we have ſhewn in the preceding Chapter for the former Conſtruction. But farther, every thing that is ſolid muſt be taken away from behind the *Traverſe*, or Croſs-piece of the Mantle-tree, (to make room for the Canal which is to take up that ſpace) and the Chimney laid in the manner, and with the Precautions mentioned in the foregoing Chapter: Then the *Traverſe* is to be ſet in its proper place again, (if it were remov'd) and the Concave fixt above it. *Fig.* 17.

Afterwards the Exteriour Air is to be convey'd to the Aperture *D* from whence it will paſs thro' all the Cavities, and hold on its Courſe in the Direction repreſented by the Serpentine Line; that is to ſay, it will riſe at firſt in the Cavity H C X I, from whence it will get thro' G Q E, into the Canal that is under the Concave, and behind the *Traverſe* of the Mantle-piece, (which Paſſage is taken away in the Figure, for the better diſcovery of the whole Route of the Air) and ſo go from S E B L to *ſ e b l*: Then the ſaid Air will iſſue forth thro' *g e q*, deſcend thro' *i h c*, paſs under the Hearth, and aſcend thro' *C c* in the middle Cavity *c C X x*; from whence it will go out thro' one of the two Apertures *R* or *r* that is left open, or thro' both together: Laſtly, certain little Doors are to be fixt on the Apertures, to determine the Quantity of Air, as alſo one of the ſmall Devices, which ſhall be hereafter deſcrib'd

deſcrib'd in the Ninth Chapter, if we would have it temper'd to any Degree that is requir'd.

As for thoſe Perſons, *Fig.* 17. who are deſirous that the Effect of this Chimney be further improv'd, 'tis an eaſy Matter for them to do it, eſpecially when the Chimney is large, by augmenting the Number of Courſes that the Air is to make therein: For that purpoſe, they need only put two Bands inſtead of one in the Spaces C A, *c a*, and leave the Space of four Inches void quite round the Chimney to the Mantle-tree; by which means ſeven Cavities will be form'd about the Chimney, beſides thoſe under the Concave, and under the Hearth, which are alſo capable of being divided; ſo as the main Body of the Air may paſs thro' all, and contract a great deal of Heat.

The Heat of the ſaid Air may be ſtill more encreas'd, by adding to this fourth Conſtruction, a fifth which we are now about to deſcribe; but all this renders the Fabrick of the Chimney more complicated, and occaſions a greater Expence: However, it has been chargeable enough already, and may be made to give as much Heat as is needfull, by working it after the manner that we have at firſt explain'd; the enſuing Conſtruction is no leſs ſerviceable, and a great deal more ſimple.

CHAP. VI.

The fifth Conſtruction not ſo much compounded as the former, in which the Air only paſſes behind the back-part of the Chimney, and is heated faſter than in the other Conſtruction.

IT was requir'd for the preceding Conſtruction, that the Pieces ſhould be of Copper-metal, yet they may be made of Iron; but it is difficult to render them very exact and neat, eſpecially the great Plate *A B G g b a* Iron-manufactures of ſo large a Size are not eaſily manag'd, nor work'd, when they conſiſt of ſo many Pieces as is requiſite: For one cannot meet with a Plate of Iron of the ſame bigneſs with thoſe of Copper, nor even that comes near their Dimenſions; and if we would joyn with any tolerable neatneſs or exactneſs the Number that is needful to be got together, the Work would coſt almoſt as much in Iron, as in Copper, and never prove ſo good. *Fig.* 9.

The ſame Inconveniency does not attend this fifth Conſtruction: The Piece may be entirely made of Iron, and it will have no leſs Neatneſs and Exactneſs than if it were of Copper; nay, it will be much more ſolid, and of a longer duration; for ſmall Plates of Iron may be found thicker than thoſe

of

of Copper generally are, and they endure the Fire a great deal longer.

It is not neceſſary in this Conſtruction, to have any Cavity under the Hearth, nor on the ſides of the Chimney, nor conſequently to line them (if it be not thought fit) either with Copper or Iron; neither is there any need of a Canal under the Concave.

To give the Air that comes from without Doors, all the Heat that is needful for warming the Chamber, it is only expedient to ſet in the back-part of the Chimney, a kind of Cheſt or Box, ſeparated on the in-ſide with certain Bands that form three or five Cells, which have a Communication one with another, and make a ſort of curved Canal in ſeveral Places.

Fig. 27.

To the end that the Workmen may more readily apprehend, and put this little Machine in execution, we are about to deſcribe every Piece by it ſelf, and lay down means for ſetting them together, as has been done in the former Conſtructions.

The firſt Piece is a Plate *C X x c* of ſtrong Iron three Foot, or three Foot and a half high, and two Foot broad at leaſt, made of two Plates joyn'd together (for no ſingle one can be found of that bigneſs) and divided into two Parts; as is ſeen in the firſt Piece of *Figure* 28, where the Lines pointed with Pricks (as in all the other Pieces) trac'd along the black Draughts, ſhew that which is to ſerve for cloſing them together.

Fig. 28. *Piece* 1.

The ſecond, third, fourth, and fifth Pieces *C g G, e f E, L h H, M m x* are four ſmall Plates, every one of two Foot three Inches in Length (if the firſt Plate be only three Foot long) and of five Inches in Breadth, not comprehending that Part which muſt be folded to joyn them together, mark'd with the prick'd Lines: Theſe Bands are to be turn'd up with a Square on the firſt Piece along the Lines *C G, f E, L h, M x*, after ſuch a manner as that the Letters of one Piece may anſwer to the ſame Letters of the other; but it is not neceſſary that they be made of ſtrong Iron, no more than the following Piece.

Laſtly, the ſixth Piece is a Plate *C g X x m c* three Foot nine Inches long, and two Foot broad: Its Extremities *C c, X x* are to be made faſt to the two Extremities *C c, X x* of the firſt Piece, and to the other Pieces in the Places where it touches them: But it is only requiſite at firſt to faſten the ſecond and third Pieces to the firſt Piece, afterwards the ſixth, then the fourth and the fifth, to the end that one may not hinder the rivetting of the others. All theſe Pieces thus united will form the Cheſt, or Box, *C g X x m c*,

Fig. 27.

m c, which is requir'd for this ſixth Conſtruction.

The Bands and Cells that are here Vertical or Perpendicular, may be ſet Horizontal or Side-ways; but we have deliver'd in Chap. 4. Pag. 76. the Reaſons why we do not give them that Situation.

Fig. 28. *Piece* 1.

The fore-plate of this Box may be made three Foot, and ſome Inches broad; and in diſpoſing of the Bands as we have but now ſhewn, there will be left on each ſide the Breadth *C H c h* of about ſeven or eight Inches: So that two ſmall Bands, but an Inch wide, are to be faſten'd to the Extremities of thoſe Pieces in all their Height; or elſe an Inch is to be folded back, to keep them in a due Poſition, and cloſe them more conveniently in laying the whole Box: And farther, they'll ſerve to form two Cells more, as will appear in the manner of fixing it, and by Conſequence give more heat to the Air that paſſes into the Box; for in running thro' a greater Courſe, it will be longer ſurrounded with Heat.

Figure 30.

This Cheſt, or Box, may (if you pleaſe) be caſt in the Metal, making it in two Pieces, which are to be afterwards joyn'd with Screws; and the Bands may be made with one of the two Pieces.

The Pieces of the ſecond and third Conſtruction may alſo be caſt, eſpecially, when there are but three Cells, tho' they are continu'd under the Hearth, which may be one of its Pieces, and the place of the back-part the other; the Bands are to be made at the ſame time of the ſame Metal.

A Method of laying the Cheſt or Box, for the fifth Conſtruction of a Chimney.

Fig. 29, & 30.

AT firſt the Model *A c c a* is to be laid on the Hearth, in order to draw the curved Line *A c c a*, and mark out the Aſh-hole K T *t k*, with the place of the Vent-hole Z: That done, a Hole is to be made in the Wall *C N n c*, about five Inches broad, and of the Height of the Cheſt, or in caſe the Wall cannot be conveniently cut, the Jambs muſt be brought more forward, if the Chimney be not of a ſufficient depth, in order to have behind the back-part *C c* of the Chimney, a Cavity *C N n c*, about five Inches deep; the Aſh-hole *K T t k* about two Inches deep, is alſo to be digg'd in the Hearth, quite to the back-part *N n* of the Cavity that was made for the Cheſt; and a ſmall Canal H Z is to be carry'd on under the Hearth, on the part from whence the Exteriour Air comes, to introduce it into the Cavity Z, that is under the Vent-hole.

Afterwards, the Cheſt is to be plac'd in the Cavity made in the back-part of the Chimney, ſo as the under-part *C c* may be rais'd about two Inches above the Hearth, and a void Space of near half an Inch remain behind the Cheſt to the top; as appears in *Figure* 31, to the end that the Air, Smoak and Heat, may paſs therein, and go out above *X x*, where certain ſmall Apertures *v, v, v*; are to be left: Then this Piece ſo laid, (which muſt not reach beyond the Line *C c* mark'd on the Hearth) is to be clos'd quite round about, except at the bottom; the ſides of the Chimney along the Curve *A H C c h a* are to be fill'd up, that it may have the Figure of the Model; the Vent-hole, (the Conſtruction of which you'll find in the tenth Chapter) is to be made faſt above the Cavity Z; and thus this Chimney will be compleated, if you would only have three Cells form'd therein. *Fig.* 30.

But if the fore-part of the Cheſt be made of the Breadth H C *c h*, in order to have five Cells, the Cavities H P N C, *h p n c* are likewiſe to be cut in the Wall; the Shape of the Model muſt be given to that Plate from *H* to *h*, and the Cheſt laid, after the manner juſt now mention'd. The laſt Band on each ſide, with the exceeding Part C H, *c h* of the Plate, and the Surface H P N, *h p n* of the Wall, are to form the two other Cells, behind which, the Heat will not paſs, but only on the back-ſide of the other three. *Fig.* 28, *Fig.* 29. *Fig.* 30.

This Chimney being thus laid and ſettled, the Air brought from without (as has been explain'd in Chap. III. Pag. 71.) being come as far as *C M* will paſs into all the Cells of the Box L H E F G, and iſſue out at G X, in order to enter the Room thro' *R*, when there are but three Cells in the Box. But when there are five, the Exteriour Air coming in at *D y* will proceed thro' G, E, H, M, to get into the Chamber thro' *r*, as is ſenſibly made appear by the Serpentine Line that goes turning in and out in this Figure; the ſaid Air may alſo be introduc'd thro' the other ſide *R*, and even thro' both at once. Again, if we would have freſh Air likewiſe enter thro' *r*; it is requiſite to convey it from the Vent-hole to *h a*, and from thence to the Aperture *r*; after ſuch a manner as the pointed Lines ſhew its Courſe in the ſame *Figure* 30. *Fig.* 30.

And farther, care muſt be taken, as much as is poſſible, that the Air which comes from without Doors, do not fall immediately and directly upon the Aperture of the Cheſt, thro' which it is to enter; eſpecially when there are

are only three Cells; but that it fetch a Compaſs for ſome time before its Ent'rance.

Altho' the Air does not here take ſo long a Courſe on the back-ſide of the Chimney as in the former Conſtructions; yet it grows no leſs warm than in the Fourth, and warmer than in the Second and Third, by reaſon that the Heat which paſſes behind the Box acts ſtrongly upon it on that ſide, as the Flame and burning Coals do before; and ſince the Bands take place on both thoſe ſides, they are in like manner heated at the ſame time: So then the Air, which in other Conſtructions receives Heat only from the fore-part of the Cavities, acquires that Quality here on all ſides, and paſſes as it were into a Canal altogether ſurrounded with Heat: And admit, that in the other Conſtructions, four or eight Moments are taken up in running thro' the whole Route the Air makes in gathering Heat, if but half that ſpace of Time be allow'd in this Conſtruction; the ſaid Air will grow warm two or three times more in every Inſtant; ſo that it is here capable of contracting as much Heat in two Moments, as it does in four or ſix in the other Conſtructions.

If we add to this Conſtruction a Cavity under the Hearth, as in the Third and Fourth, and immediately cauſe the Exteriour Air to paſs into it, and from thence into the Cheſt, its Effect will be more conſiderable; which would be ſtill further augmented, and the Chimney render'd more neat, if its Sides were cas'd with thin Plates of Copper or Iron, or only with Tin.

In order to introduce freſh Air, and temper it as you pleaſe, 'tis expedient to make uſe of one of the following Methods hereafter explain'd in the ninth Chapter.

Upon the whole Matter, this fifth Conſtruction is ſo uncompounded, ſo convenient, ſo facil, and of ſo little Expence, that 'tis probable it will become the moſt general; and I my ſelf at this Inſtant apply it to very good Purpoſe.

CHAP. VII.

The Sixth Conſtruction for Chimneys, that cannot have a Cavity behind the Back.

THERE are ſome Chimneys in which a Space cannot be taken in the Wall of the Back, either upon account of its being a Party-wall, and the Neighbour will not ſuffer it; or becauſe there is another Tube therein, ſtopt only with a piece of Brick of about four Inches in the thickneſs; or otherwiſe, in regard that thoſe Chimneys cannot be ſet forward in the Chamber, or they are not deep enough to have the proper Cavities behind the Plate.

In that caſe it is requiſite to take theſe Cavities only in the Jambs, and under the Hearth, and (if it be thought fit) to make the Canal of the lower-part of the Concave. 'Tis ſuppos'd that the preceding Conſtructions have been perus'd, and therefore we ſhall not repeat what has been already deliver'd upon that Subject.

It is not neceſſary for this ſixth Conſtruction, to make the Sweep of the inſide of the Chimney of one ſingle Piece, as in the former; the Back may be left in the ordinary form, and the Round of the Model given to the two Jambs: But both its Sides from the Back *C c* to the Mantle-piece *A a* are to be lin'd with Copper or Iron; leaving behind a void Space of four Inches in depth; each of theſe Sides is to be divided into two Parts by the Bands H I, *h i*, and the Space under the Hearth, which was digg'd about four Inches deep, is to be divided in like manner by another Band *H h*.

Fig. 23.

Suppoſe we now that the Air begins to come into the Cavities D A H, and paſſes under the Hearth in *A H*, *h a*; it will ſet out from thence thro' *A h*, riſe up in *h a b i*, go down again thro' *i h c* (if there be no Canal under the Concave) enter the ſecond Cavity *c h* H C under the Hearth, and aſcend into H C X; from whence it will iſſue out in order to get into the Chamber thro' *R*, after it has acquir'd Heat in all thoſe Cavities.

But if there be a Canal in the Plane of the Chimney-piece, the Air after having paſs'd from *D* thro' the Cavities *H A a h*, *h a b i*, will get thro' *i g q* into the Canal *b e s*, S E B, under the Concave; then it will go down again thro' I X C H, in order to paſs into the ſecond Cavity *H C c h* under the Hearth; there to riſe in *c h x*, and afterwards enter the Room thro' *r*; ſo that the Space A H I B, being of no uſe, may be left fill'd up.

Fig. 24.

It is evident that this ſixth Conſtruction, does not differ from the ſecond, third, or fourth, more than with reſpect to a greater or leſſer Degree, and that in joyning all together, and taking what is judg'd expedient from every one of them, according to the ſeveral Diſpoſitions, Situations, or Dimenſions of Places, *&c.* many other different Conſtructions may be form'd, that will all have the ſame Effects, tho' in different Degrees; which depends on the *Genius* and Skilfulneſs of the Builders who put them in Execution, according to the reſpective Places where they are to be ſet, and the Expences deſign'd to be laid out.

The Air is to be temper'd in this ſixth Conſtruction, as in the others.

CHAP.

CHAP. VIII.

The Seventh Conſtruction for the Chimneys of great Halls and other publick Warming-places.

* *Chauffoir.*

THE Conſtructions we have explained in the preceding Chapters, are only for the Chimneys of ordinary Chambers or Cloſets, but for great Halls, and the Warming-places of Colleges or other publick Societies, it is requiſite to vary a little from the Proportions before laid down: In the large Chimneys of thoſe ſpacious Places, the Wood is uſually burnt entire, and indeed it ought to be ſo, eſpecially at *Paris*, where the Billets are but of 3 Foot 8 Inches in Length: So then, to the End they may lie cloſe to the Back of the Chimney, without being ſaw'd or cut ſhorter, it is expedient, for making the Model *AHC c h a*, to take at firſt the diſtance *C c* of the Sides at the Back-part of the Chimney, 3 Foot 8 Inches, and the Line *A a* of 7 Foot, or ſomewhat more or leſs; we therefore ſuppoſe it here of ſuch a Dimenſion, as is fit to determine, the Aperture of the Fore-part of the Chimney, and the Length of the Mantle-piece. *Fig.* 7.

Then the Lines *A B*, *a b*, 2 Foot long are to be drawn, for the Meaſure of the Depth of the Chimney, and *C G*, *c g*, of five Inches each; the Lines *A G*, *a g*, are likewiſe to be taken, with *G H*, *g h*, each of 7 Inches; the two Points *C* and *H* are to be joined by an Arch of a Circle, the Center and *Radius* of which may be found, after the manner expreſſed in the firſt Chapter of this third Book; and thus we ſhall have in *AHC c h a* the Line or Stroke of the Model for thoſe great Chimneys: Or if it be judged more adviſeable to make the two Sides Parabolical, it may be done according to the Method ſet forth, in the ſame firſt Chapter; ſuppoſing the two Lines *C D*, *c d*, diſtant 3 Foot 8 Inches from each other, and the Points *A a*, at the diſtance of about 7 Foot; and one of the fore-going Conſtructions is to be made uſe of to build the Chimney, with one of thoſe two Models. *Fig.* 8.

The moſt ſimple Conſtructions are always ſufficient for theſe large Chimneys, becauſe the Cavity at the Back being deeper and longer than in the ordinary Chimneys, it contains a very conſiderable quantity of Air, a ſmall Part whereof only goes out every Moment; ſo that a great deal of this hot Air continually remains, with which the freſh that enters mingles together, and ſoon grows warm: Beſides, that the Fire being ſpread out farther, and more vehement, it conſequently communicates a more intenſe Heat to the Air of that Cavity, which ought

ought to be made about 5 Inches deep; leaving at the Places where it gives the Air Ingreſs or Egreſs, and in all the Parts through which it is to paſs, an Aperture near upon of 80 ſquare Inches.

When theſe Chimneys are contrived for great Societies or Companies, they may be erected (whenever it is convenient) in the middle of the Chamber or Hall; and two may be ſet (if any would have it ſo, or it be needfull on the Back of each other, to the End a greater Number of Perſons may ſee the Fire on both Sides. The ſame Cavity in the Back-part would ſuffice for theſe two Chimneys, which will heat the Air, whether the Fire be made in one or in the other, and to a greater Degree when it is kindled in both together.

Otherwiſe, if there were two diſtinct Warming-places, ſeparated by a ſingle Wall, againſt which two Chimneys were built Back to Back, after the manner but now mentioned, we might only upon lighting a Fire in either of them, warm the two Places, by leaving an Aperture in each, to let the hot Air, ſometimes into one, and ſometimes into the other, or into both together; and a Part of the Society might continue in that Room where the Fire is, and the reſt in the other, accordingly as it would be convenient for every individual Perſon, either to have a Sight of and draw near the Fire, or to keep himſelf warm without ſeeing it.

In common private Apartments, when there are Chimneys ſet thus on the Back of each other, a ſingle Cavity may alſo be cut and divided into Cells, between the two Backs; and by making a Fire in either of thoſe two Chambers that is judged moſt expedient, they may be both heated, as has been juſt before explained.

CHAP. IX.

Of proper Means for tempering freſh Air that enters the Chamber, to ſuch a Degree as ſhall be deſired.

IF any Perſons are diſpoſed to let in through the Apertures *R* or *r*, one while hot Air, ſometimes cold Air, and ſometimes both together, in order to temper it to any Degree at pleaſure, and by that means to augment or diminiſh the Heat of a Chamber, without encreaſing or abating the Fire; it is requiſite that near the Aperture *R* or *r*, through which the hot Air enters the Room, there be a Communication with the Place *y*, from whence the Exteriour Air comes in directly, before its paſſing through the Cavities, where it acquires Heat; and to take Care that that Device which ſerves to open an Entry for the hot Air, may ſhut out the cold *Fig.* 17. 18, *&c. and* 30.

cold Air, and ſo reciprocally; or that it ſometimes cloſe up one and ſometimes the other, or ſuch Part of either, as is thought fit: Several Means might be found out for this Purpoſe, but we ſhall only here ſubjoin ſome that are very ſimple and moſt eaſy to be put into practice.

Fig. 10. 11, 16, 17. It is expedient then to provide two Concave Cylinders, like round Boxes or Barrels, that turn one within another; the Diameter of the greater being about 1 Foot, and the Height 9 Inches; the three Apertures *g l*, *m n*, *d p* are to be made every one 5 Inches broad and 8 Inches high; the Space *l m* of 6 Inches in breadth is to continue filled up, as well as *n d* of two Inches, and the remaining Part *p g*: In the leſſer or inner Cylinder *q c* 6 Inches broad is to be left open; *b c* and *q y*, of 6 Inches each, filled up; and the remaining Part *y b* 8 Inches high open: A ſmall outjetting Piece is alſo to be left between *n* and *d*, which may enter the Aperture *q c*, to the end that the leſſer Barrel in turning about, may be ſtayed, when the Points *q* or *c* ſtrike againſt it.

Fig. 16 17, 30. To fix this double Cylinder, the Aperture *n m*, is to be ſet over againſt the Place, through which the warm Air goes out of the Cavities behind the Chimney; the Space *p d* over againſt the Part, through which the cold Air comes in; and *g l* over againſt that through which the Air is to enter the Chamber; as may be ſeen in the Figures 16, 17, and 30; and when *y q* is over againſt *p d*, the hot Air alone, or that which has paſſed through all the Cavities of the Chimney, will get into the Room: But if *c* be turned over againſt *n*, none but cold Air or that which immediately comes from without Doors, will any longer enter; for the Aperture *m n*, through which the warm Air proceeded, will be ſtopt. But if the Point *c* were only brought forward to the middle of the Aperture *n m*, half *p d* would be open; ſo that ſome hot Air and ſome cold would paſs into the Cylinder, which would go out at the ſame time mingled together through the Aperture *q l*; again if we only ſtop a third Part of *n m*, a third Part of *p d* will only be left open; and ſo of the reſt.

Fig 6 11, 17, & 30. To cauſe the inner Cylinder to turn about, as one would have it, 'tis requiſite at the extremity of the *Axis e* to faſten a kind of Needle or Index *g o* which may come out in ſome Part of the Mantle-piece (if it can be done) or any where elſe in the Room: And by marking on the Compaſs it takes, in order to open or ſhut the Apertures of the Cylinders, an Arch of a Circle and certain Degrees thereon; any one may ſee by turning and puſhing this Index with

with the tip of his Finger, how each of thoſe Apertures, through which the hot and cold Air paſs, opens or ſhuts cloſe.

Fig. 10. 11. If the Space *c b* of the Breadth of *d m*, or of its equal *n p*, were only left fill'd up in the leſſer Cylinder; the three Apertures of the great Cylinder, might be ſucceſſively cloſed, or all three left open, or that only left open in *p d* which would be ſhut in *n m*, and ſo reciprocally.

Fig. 12. But farther, a Part of theſe two Cylinders may alſo be cut off, ſo as only to leave *p d n m* of the greater, and *c b* of the leſſer, as appears in the 12th Figure; neither would there be any need of ſo much Room, to let this little Machine in, which is not only as exact but even more convenient and ſimple than the other. The following Devices are no leſs advantageous, and made altogether of right Planes.

Fig. 13. 14. Two little Frames *p d*, *n m* are to be firſt joined together ſquare, the Breadth of the Aperture *p d*, *n m* of each being 5 Inches, and the Height, repreſented in the 14th Figure, 8 Inches: In the Angular Point of the Square a Spindle *c b* is to be fixed, which may alternatively ſhut both thoſe Frames, that are to be ſet ſo as one of the Apertures may anſwer to the Place through which the Air comes from behind the Chimney, and the other to that thro' which the Exteriour Air immediately paſſes; as is ſeen in the 16th Figure: Afterwards to the end that the ſaid Spindle may be conveniently diſpoſed of for opening and ſhutting, and even left open at any diſtance that is thought fit; 'tis requiſite to faſten to one of its Extremities on which it goes about, a ſmall *Axis* inſtead of a Turning-joint, at the end whereof a kind of Needle or Index is alſo to be put and conveyed to the Place where it may be more readily ſet a playing.

And foraſmuch as this *Index* muſt deſcribe a Quadrant or fourth Part of a Circle, to cauſe the Spindle to go from one Frame to the other, which would take up a conſiderable Space, when the Needle is long, or would be ſometimes obliged to make it; in that caſe, a ſmall Pinnion may be fixt on the Extremity of the *Axis* in which is to be ſet a Wheel of any Size that ſhall be judged moſt expedient, or only a Part which would cauſe the Spindle to make the Quadrant, by running thro' but a ſmall Space; and ſerve to ſhew how far it is diſtant from either of the Apertures of the Frame, and by conſequence, what Air hot or cold enter'd, and how much of each.

Inſtead of a ſingle Spindle *c b* two might be applied, that is to ſay, one to each Frame, ſo as to make them open either on the inſide or the outſide; by joining them

them together, according as the one opens and the other cloſes itſelf; and by ſeparating them, they may both remain entirely open or ſhut.

If the two Apertures thro' which the hot and cold Airs are to iſſue out, were in the ſame Plane, a ſingle Frame would be ſufficient, wherein there ſhould be a ſingle Channel or Gutter 6 Inches broad, and 8 Inches long; which might ſerve to open ſometimes one, and ſometimes the other of the two Apertures that are left there, or Part of one and Part of the other, and which might alſo leave them both open, whenever it is required, the manner whereof may be eaſily apprehended.

CHAP. X.

Of the Conſtruction of the Vent-Hole.

THE Vent-hole the uſes of which we have ſhewn in the preceeding Books is a Machine as ſimple as it is convenient, and may be made in the following manner. In a ſmall Frame of Iron or Copper, the Aperture of which is about 3 Inches in Length and 2½ Inches in Breadth; or in an Aperture of the like Dimenſion in the Hearth-plate (when there is one) a ſmall Trap-door Z that ſhuts cloſe, is to be made faſt with a Turning-joint; and inſtead of driving an Iron-pin or Leaf into the Frame to hold faſt this little Door, the Edges of both are to be bezelled or ſloap'd Chamfer-ways, to the End that no Aſhes may lie there, ſo as to hinder the Door from ſhutting cloſe.

Fig 6 9, 17, 30.

On the Side oppoſite to the Turning-joint, a ſmall Button is to be ſet, in order to raiſe up this Door with the Tongs and (if you pleaſe) a little Bolt underneath, which may be drawn back or cloſe with the Button above, that ſerves to move it: On each of the two other Sides is to be fix'd underneath a Sector or ſmall Part of a Circle, ſo as the Center of it may touch the Turning-joint, to the end that the Wind may only go out before, and blow directly upon the Fire, when the Trap-door is lifted up; and for the more ready keeping of this Door open, at any Height that is judged convenient, accordingly as one would have more or leſs Wind, two ſmall Springs are to be faſtened under the Frame, each of which muſt be againſt the Limbs of the Sector-pieces, and ſufficiently preſs them, ſo as to keep the Door faſt at any degree of opening. The Draught of this Trap-door is repreſented on the Side of the firſt Piece of the 9th Figure.

When the Hearth is not covered with an Iron-plate, as in the

with the tip of his Finger, how each of thoſe Apertures, through which the hot and cold Air paſs, opens or ſhuts cloſe.

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Fig. 13. 14. Two little Frames *p d*, *n m* are to be firſt joined together ſquare, the Breadth of the Aperture *p d*, *n m* of each being 5 Inches, and the Height, repreſented in the 14th Figure, 8 Inches: In the Angular Point of the Square a Spindle *c b* is to be fixed, which may alternatively ſhut both thoſe Frames, that are to be ſet ſo as one of the Apertures may anſwer to the Place through which the Air comes from behind the Chimney, and the other to that thro' which the Exteriour Air immediately paſſes; as is ſeen in the 16th Figure: Afterwards to the end that the ſaid Spindle may be conveniently diſpoſed of for opening and ſhutting, and even left open at any diſtance that is thought fit; 'tis requiſite to faſten to one of its Extremities on which it goes about, a ſmall *Axis* inſtead of a Turning-joint, at the end whereof a kind of Needle or Index is alſo to be put and conveyed to the Place where it may be more readily ſet a playing.

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CHAP. X.

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On the Side oppoſite to the Turning-joint, a ſmall Button is to be ſet, in order to raiſe up this Door with the Tongs and (if you pleaſe) a little Bolt underneath, which may be drawn back or cloſe with the Button above, that ſerves to move it: On each of the two other Sides is to be fix'd underneath a Sector or ſmall Part of a Circle, ſo as the Center of it may touch the Turning-joint, to the end that the Wind may only go out before, and blow directly upon the Fire, when the Trap-door is lifted up; and for the more ready keeping of this Door open, at any Height that is judged convenient, accordingly as one would have more or leſs Wind, two ſmall Springs are to be faſtened under the Frame, each of which muſt be againſt the Limbs of the Sector-pieces, and ſufficiently preſs them, ſo as to keep the Door faſt at any degree of opening. The Draught of this Trap-door is repreſented on the Side of the firſt Piece of the 9th Figure.

When the Hearth is not covered with an Iron-plate, as in the

Figures 18. 19, and 20 ſmall Cramp-Irons are to be drove in under the Frame of the Trap-door, in order to make faſt and ſettle this Vent-hole in the proper Place where it is to be ſet, *viz.* at the diſtance of 12 or 15 Inches from the middle of the Ground-plot of the Chimney, and above the Cavity cut in that Part, where the Exteriour Air is to enter through a little Channel marked *HZ*.

Fig 18. 20, 30.

Fig. 15. 17.

PART II.

Of the Conſtructions of the Shafts of Chimneys, as well to augment Heat, and hinder ſmoaking, as to quench Fire that breaks out therein.

WE have in the Second Book, already taken notice of certain Machines that may be added on the top of the Funnels of Chimneys, to prevent their ſmoaking: But to the end they may be more readily put into practice; it is expedient particularly to ſet down all the Proportions even of every individual Piece.

We have alſo declared, that 'tis requiſite to uſe all poſſible means, to ſecure the Tunnels from being commanded; that is to ſay, that there be nothing near them rais'd to a greater Height; and indeed, this is one of the moſt neceſſary Precautions. It is farther adviſeable in the erecting of Tunnels to place them as much as can be well contrived one on the Side of another (as is now very commonly done) becauſe the Second of the Conſtructions we are about to explain, may be more eaſily laid, whenever it is needful or Occaſion requires.

CHAP. I.

Of the firſt Conſtruction of the Shafts of Chimneys on the out-ſide.

THIS firſt Conſtruction will not appear new to abundance of People; ſince there are many Chimneys which have Devices much of the ſame nature on the top; nevertheleſs in regard that it is not ſo general, nor perhaps ſo regularly executed as it might and ought to be, to have its entire Effect, and it even conſtitutes part of the Second Conſtruction produced in the next Chapter; we think our ſelves obliged to give the following Explication thereof.

Sup-

Suppoſe the Funnel or Shaft of a Chimney, the length of the Aperture of which *A a* at the top is 30 Inches in the Clear, *i. e.* on the inſide, and its Breadth *A B* 10 Inches, two Inches are only to be encloſed quite round about, with which the lower Part is to be brought down ſloping in the Chimney; ſo that the Aperture will not be above 26 Inches long, and 6 broad: The length in *C D*, *c d*, is to be divided by two Partitions of 4 Inches each, the lower Part whereof is to go down in an Angle in the Tunnel, and there will remain three Apertures every one of 6 Inches ſquare.

Fig. 32.

Fig. 24. & 36.

Fig. 32.

Afterwards, three trunked ſquare and concave Pyramids are to be raiſed, the Baſes of which on the inſide are from 11 to 12 Inches ſquare, and the Apertures of every one on the top from 5 to 6 Inches ſquare, which are to be divided into two Parts by a ſmall Band 2 or 3 Inches high, laid in a different Situation; as is ſhewn by the pointed Lines in the Pyramids *A E G D*, *D I M D*, *d e g a*, whoſe Height is from 12 to 15 Inches.

Fig. 32.

Then theſe three Pyramids are to be laid and fixt near one another, above over the Apertures *A B C D*, *D C C D*, *d c b a* of the Funnel, after ſuch a manner as the Letters of the Baſes may anſwer to the ſame Letters of the Apertures; that the Line *B A* in one, lie upon the Line *B A* in the other, and ſo of the reſt; and thus we ſhall have the firſt Conſtruction, which is ſufficient for the moſt part of Chimneys: But when the whole deſired effect is not produced, the Second Conſtruction is to be added, or rather the ſecond Part of the Second, of which theſe Pyramids conſtitute the firſt.

If the Aperture of the Chimney prove leſs than has been here allowed, the Openings or Holes of the Pyramids are to be diminiſhed; and if it be greater, they muſt be made wider, or elſe four ſet in the Room of three.

Theſe Pyramids may be made of Plaiſter or Potters-clay, bak'd as other Earthen Veſſels are; or of Tin, eſpecially when one would add the Capital, we are about to deſcribe in the enſuing Chapter.

CHAP. II.

Of the ſecond Conſtruction of the top of the Funnels of Chimneys,

Fig. 33. THE Pyramids being made and fixed after the manner but now related in the preceeding Chapter; the Capital is to be added on the top, every piece of of which we ſhall here explain in particular.

The firſt and ſecond Pieces are two Boards *AHLMOB*, *ahlmob*; (all the Lines marked in theſe two Pieces with the ſame Letters are equal, ſo that it is ſufficient to determine them in one; and indeed, when one of them is drawn and cut out the other may be taken from that Model) the breadth *AB* at the bottom is from 13 to 14 Inches, as well as *GP*; the Height *AG* or *BP*, 8 Inches; *GH* or *PO* 6 Inches; as well as *HI* and *ON*; the Breadths *HO* and *IN*, 12 Inches; *IL* and *NM* each 8 Inches, and *LM* 5 Inches: *QRS* is a Triangle to be voided, *i. e.* have the Wood cut out, the Baſe of which, *QS* in the ſame Line with *IN* is 6 Inches long, and the two Sides *QR*, *RS* each 7 Inches; *AEFB* ſhew the Part which muſt anſwer over againſt the Surface *AEFB* of the Pyramid *AEGD*, when the Pieces of the Capital are ſet together, and laid on the Chimney.

Fig. 35.

Fig. 32.

The third Piece *SRQ*, *qrs* is a Tin-plate 30 or 32 Inches long and 14 broad; which is to be folded in the middle along the prick'd Line *Rr* to make a kind of Gutter, or a Triangular Priſm, by covering the upper Part of it.

Fig. 35.

The fourth Piece *GLlg* and the fifth *FMmp*, are two other Tin-plates, each likewiſe about 32 Inches long, and 20 broad, indented on one Side along their Length, as appears in the Figures; ſo as *LT*, *ux yz*, *&c.* may be each 5 Inches long, and the Lines *TI*, *IV*, *&c.* every one 7 Inches. The prick'd Lines *Hh*, *Ii*, *Oo*, *Nn* mark the Places, where thoſe Pieces muſt be folded, in order to rivet them on the two firſt Pieces; and one of the ſaid Pieces being cut out, the other may be cut upon it: They are alſo made as well as the third, of Tin rather than Iron; becauſe the Rain ſoon produces on the latter a ſort of Ruſt that would eat thro it in a ſhort time.

To cloſe theſe 5 Pieces, the two firſt are to be ſet upright or perpendicularly before, and at the diſtance of 30 Inches one from the other; that is to ſay, at a diſtance equal to the length of the Aperture of the Chimney: That done, to theſe two Pieces the third muſt be made faſt by its Extremities, which are to be let into the Triangles *QRS*, *qrs*, by folding it as much as is requiſite: Then the fourth and fifth Pieces muſt likewiſe be faſten'd thereto, by bowing them as far as is needful, to cauſe their Extremities *GHIL*, *ghil*, *PONM*, *ponm*, to reſt upon the Edges of the two firſt, in beginning from *GP*, *gp*.

All theſe Pieces thus joined together are to be laid upon the three Pyramids, ſo as the Line *Rr* of the Piece made in form of a Triangular

Fig. 32. 33.

gular Priſm may anſwer to the middle of the Apertures on the top of the three Pyramids, which it will not be neceſſary in that caſe to divide in thoſe Places: The Extremities *A B*, *a b*, of the two firſt Pieces are to bear upon the two Sides *A B*, *a b*, of the Tunnel of the Chimney; then the whole Fabrick is to be ſtay'd and well ſettled in this Poſition, and it will produce the ſecond Conſtruction.

Fig. 35.

If you do not think fit to make the two firſt Pieces of Wood, becauſe they may burn if a Fire ſhould catch in the Chimney, and even wear out ſooner than you would have it; one of thoſe Pieces may only be cut out to ſerve as a Model, in order to raiſe a Wing of Plaiſter-work of the ſame Figure on each ſide of the Chimney, above *A B*, *a b*; and afterwards to faſten and fix the third, fourth and fifth Pieces (on the top and in the middle after the manner we have juſt now ſaid is requiſite to be done on the firſt and ſecond Pieces.

But if it be judged more expedient to make the two firſt Pieces likewiſe of Tin, as well as the trunked Pyramids, the Machine may be brought ready made to the top of the Chimney; and we ſhall be more certain of its being well executed; ſince there will be no difficulty at all in the laying of it.

CHAP. III.

Of the Conſtruction of the Tunnels of Chimneys on the inſide, to quench Fire there, to preſerve Heat in the Chambers during the Night, and to hinder the Smoak of a neighbouring Chimney from entering; and of the Fire-cover.

THE Fire-cover that ſerves to extinguiſh Fire on the Hearth, or to preſerve Heat in the Night, the uſe of which is well known, and the two Regiſter-plates that are no leſs ſerviceable to quench Fire in the Chimneys, to retain Heat in the Rooms even during the whole Night, and to hinder the Smoak of neighbouring Chimneys from ruſhing in, (as it often happens when there is no longer any Fire) are Machines ſo plain and uncompounded, that what has been ſaid on this Subject in the firſt Book ſeems ſufficient to cauſe their Conſtruction, the manner of their being put into practice, and the means of uſing them to be readily apprehended.

However, to the End that Workmen who are leſs skilful or ſagacious, may not ſtand in need (if it be poſſible) to ſeek for other Inſtructions different from thoſe they'll here meet with, we ſhall proceed to give a more particular Account of theſe little Devices,

Devices, than has been done in the Places where we have already made mention of them.

Two Iron-plates *S T t s* (*Fig.* 25. and 34.) *N O o n* (*Fig.* 26.) exactly of the ſame length and breadth as the Aperture of the Tunnel in the Parts where they muſt be ſet, ſuffice to conſtitute the Machine for the inſide of the Chimney. *Fig.* 25. 26, & 34.

The firſt Plate *S T t s* is traverſed in the middle of its length with a ſmall *Axis pP* the two Ends or *Tampins* of which *P p* ſtand out about 1 or 2 Inches; and two Wires *V M u m* are fixt in the middle of both thoſe Extremities *V u*, in order to put them in the Poſition that is judged expedient.

The ſecond Plate *N O o n*, has its Tampins *N O* or *n o*, at its two Extremities *N n* or *O o*, and a ſmall Iron-rod *I H* in the middle *I*, to raiſe it up or let it down at pleaſure. *Fig.* 26.

To lay the firſt Regiſter-plate *S T t s*, in the two oppoſite Faces or Sides of the Shaft of the Chimney, about 2 Foot from its Aperture on the top, two Holes *P p* are to be cut over againſt one another, in the middle of the breadth of thoſe two Faces: Two Iron-rings or Eyes, are alſo to be fixt there, in order to let in the Tampins *P p* and an Out-jetting Ledge ſet on the inſide of the Chimney, to the end that the Plate may be kept ſtraight or cloſed up as you pleaſe. Laſtly, the Wires *V M v m* are to be brought down to the bottom of the Chimney, in the Room and faſten'd there, to be made uſe of in opening and ſhutting the Regiſter-plate whenever it is needful. *Fig.* 25. 34. *Fig.* 24. & 36.

Inſtead of putting ſmall out-jetting Ledges in the Sides of the Shaft, to keep the Regiſter-plate tight, and clos'd up, when brought to a level Poſition; it may be made ſomewhat longer than the Aperture of the Chimney is, and then it will continue ſo ſhut before it becomes altogether parallel to the Horizon or upon the Level.

To fix the ſecond Regiſter-plate *N O o n*, two Holes are likewiſe to be cut in the Corners of the lower part of the Funnel, to let in the two Tampins *N n*, or *O o*, after ſuch a manner as is moſt convenient for the opening thereof; but 'tis more adviſeable, (if it can be done) that the ſaid Plate open according to its length *N O*, that the two Tampins be ſet at the two Corners *N* and *O*, and that being open, it lie along the bottom of the Chimney, where it is ſtay'd by the Rod *H I* hanged upon a Hook on the fore-part in *h*. *Fig.* 24. & 31.

As

As for the Fire-cover, which may be made of Copper, Iron, or Tin, it is a ſort of Box without a Lid, 2 Foot long, about 10 Inches broad, and 6 Inches high from its Aperture to the bottom, with a Handle, whereby it may be conveniently removed: 'Tis no great matter how many Pieces this Box conſiſts of, but if it be made of Tin it is expedient to faſten the ſeveral Plates with Rivets and not to be contented only with ſoldering them; otherwiſe they'll not continue long joined together.

Fig. 24. 31, & 32. The two Regiſter-plates being placed within the Chimney if the Fire happens to break out therein; it is only requiſite to take away the burning Brands out of the Hearth, and ſhut down the ſaid Plates (as has been already intimated) by drawing the Wire *M v* (*Fig.* 24. and 32.) of the upper Plate which ſerves for that uſe, and the Rod *I H* (*Fig.* 31.) of the lower Plate; and the Fire will be immediately quench'd; it would go out indeed, if one of thoſe Regiſter-plates were ſhut, but not ſo ſoon, and then the annoyance of Smoak would be ſuffered till the Fire is quite extinguiſhed, if the upper Plate were only cloſed: To avoid this Inconvenience, the fore-part of the Chimney may be ſtopt, with a wet Cloth, *&c.* and Water thrown upon the Brands, the Vapours of which will help to put out the Fire in the Tunnel; but it is convenient if there be two Regiſter-plates to ſhut them both down.

It happens very frequently, when there is no Fire, that the Smoak of a neighbouring Chimney gets into another that ſtands near it, which may be eaſily prevented by keeping the upper Regiſter-plate ſhut cloſe.

This Plate laſt mentioned may alſo be made uſe of every Evening, to hinder the exteriour Air from ent'ring and cooling the Chamber in the Night: But 'tis requiſite before it is cloſed that there only remain on the Hearth Coals or Embers, that do not ſmoak any longer; otherwiſe the fore-part of the Chimney muſt be ſtopt, and the whole Funnel left open.

If you have a Fire-cover at hand, it may be us'd upon this Occaſion, to quench the whole Fire on the Hearth, before the Regiſter-plate is let down; for which Purpoſe 'tis only needful to lay the ſaid Cover over the Fire, after ſuch a manner as no Air can get in underneath.

The ſame thing is to be done, when in the Evening, or upon your going out of the Room, you would have the Fire put out, but if you are deſirous that it be kept all Night, or even in the Day, 'tis requiſite to cover the Embers that are left, and the ſmall lighted

Brands

Brands with Aſhes, to put the Wood that remains unburnt upon them, and to lay the Fire-cover over all; taking care that a little Air may enter thro' ſome Place underneath; and then the Fire, almoſt without decaying, will continue a very long time, and keep the Brands warm, which may be ſtill more eaſily kindled again, whenever we think fit; But there is no need of letting down either of the Regiſter-plates in that Caſe, ſince the fore-part of the Chimney muſt be ſtopt, when we would not have hot Air go out, nor cold Air come in.

PART. III.

Of the Uſes and Effects of the New-invented Chimneys, and and of the manner of putting them into practice.

IT is not ſufficient that Workmen are capable of raiſing certain Structures; but 'tis even requiſite that they know the Advantages and Effects, as alſo the various Ways of uſing them, not only for the more ready executing and bringing them to perfection, but farther to render them uſeful to the Gentlemen for whom they are built, and that have no Skill or Experience in thoſe Affairs: To the end therefore, the ſaid Workmen may here find every thing that we judge neceſſary for their Inſtruction, relating to theſe Chimneys; we now come to add this third Part of the third Treatiſe in which we are obliged to repeat ſome things that have been already delivered in the two former Books.

CHAP. I.

Of the Effects and Properties of theſe Chimneys.

BY means of theſe Chimneys built after the manner before particularly ſet forth, we ſhall gain the following Advantages.

1°. To kindle a Fire very quick, and ſee it continually flame, without being obliged to blow it, and without making uſe of Bruſh-Faggots, be the Wood that is burning ever ſo large or green. *Chap. 4. Book 1.*

2°. To warm a ſpacious Chamber in a ſhort time, with a little Fire and even to afford Heat to a ſecond adjacent Room. *Chap. 2. & 3. B. 1. p. 2.*

3°. To

3°. To augment or diminiſh the Heat in a Chamber, without encreaſing or abating the Fire. *Ch.* 3. *B.* 1. *P.* 2.

4°. To warm one's ſelf at the ſame time on all ſides, be the Weather ever ſo cold, without ſcorching his Legs, Eyes, or Face, (tho' before the Fire) as is done in the common Chimneys; and by that means to free one's ſelf from all the Inconveniencies occaſioned by exceſſive cold Weather, and a too vehement Fire, and from thoſe they leave after them. *Ibid.*

5°. To hinder cold Air from paſſing into a Room, thro' the ſmall Chinks of Doors and Windows not ſhut cloſe, and that little which enters, from ſtriking cold upon our Bodies, if we are at ever ſo ſmall a Diſtance from thoſe Doors and Windows. *Ibid.*

6°. To cauſe a warm Air continually to range about us, tho' we be at a diſtance from the Fire, and ſo always keep our ſelves warm in the moſt violent cold Seaſon, without being oblig'd to go near the Fire. *Ibid.*

7°. To warm a Bed, even while any Perſon is in it, without bringing Fire thereto, and to cauſe a hot Air inceſſantly to ſurround the Party whom we would have warm'd, and kept in that Temper. *Ibid.*

8°. To take in by Reſpiration an Air that is always freſh, and to what Degree of Heat you pleaſe; and by that means to avoid drying up or conſuming your Lungs. *Ibid.*

9°. To expel in a ſhort time all the Air of a Chamber, and cauſe it to be ſucceeded by freſh Air; heating the Room to ſuch a Degree as is thought fit, even during the ſevereſt Winter, and drying it when the Weather is ever ſo moiſt: And by that means to ſecure one's ſelf from the Annoyances and Diſeaſes which may be occaſion'd by an Air cloſe pent up, and render'd infectious, ſuch as is uſually found in the Apartments of ſick Perſons. *Ibid.* & *Ch.* 4.

10°. To be always free from the leaſt Moiſture in one's Chamber, even during the thickeſt Fogs, and Thaws of the longeſt Continuance; and ſo entirely to preſerve his Houſe-hold-goods at all times. *Ibid.*

11°. To retain Heat in a Room in the Night, after the Fire is put out. *C.* 1. 2, 3. *B.* 2. *P.* 3.

12°. To have the Grievances that take riſe from Smoak abſolutely redreſs'd; and ſo never to be in danger of loſing one's Sight, or enduring the Attacks of other Maladies occaſion'd thereby; nor of having his Linnen or Lace ſmutted, Houſe-hold-Furniture ſpoil'd, &c. *B.* 2.

Ch. 2. B. 1. P. 3. 13°. To quench by one's ſelf, and in an Inſtant, any Fire that may catch in the Tunnel of the Chimney.

Ibid. 14°. To hinder the Smoak of an adjacent Chimney from paſſing thro' that of any Perſon into his Chamber.

15°. To be capable of performing many particular and remarkable Chymical Operations with great Facility.

CHAP. II.

Of the manner of uſing the new-invented Chimneys.

TO kindle a Fire in theſe Chimneys, it is only requiſite to have a ſmall burning Coal, or even a piece of lighted Paper, and lay it between two Brands, or near the hot glowing Embers, (if any be left) and to open the Vent-hole, and the Wood will be quickly ſet all in a Flame. *Fig. 6, 17, 18, 19.*

Foraſmuch as this Vent-hole ſends forth ſtronger Blaſts, accordingly as a leſſer Quantity of Air comes into the Chamber from other Parts: When there is no Wind ſtirring, and the Weather not very cold, ſo that the Air enters leſs ſenſibly thro' the Vent-hole; the other Paſſages by which the Exteriour Air comes in, may be ſtop'd, provided the Chimney does not ſmoak; otherwiſe it is more expedient to leave them open, and ſtay a little longer, till the Fire be thoroughly kindled.

When the Weather is very ſharp, the Wind always enters with impetuoſity thro' the Aperture *R* that leads into the Chamber; ſo that before the Cavities of the Chimney thro' which it muſt paſs, are heated, it comes in very cold, when this Aperture is not ſhut at the ſame Inſtant; nevertheleſs it is expedient to leave it open, if the Courſe of the Smoak cannot be otherwiſe prevented: But Care muſt be taken to make the Flame beat near the Back, or the Ground-plot of the Chimney in the ſecond, third and fourth Conſtructions, and to cauſe it alſo to paſs underneath in the fifth, to the end it may ſoon warm the Air that goes into the Cavities. *Fig. 6, 17, 30.* *Fig. 17, 18.* *Fig. 30.*

And to promote the Operation of the Fire in heating the ſaid Air ſtill more ſpeedily, part of the Aperture D may be clos'd, thro' which the Air from without enters; for the leſſer of it comes in, the other Air grows warm ſo much the faſter: But ſuch a Quantity muſt be continually let in as is ſufficient to hinder Smoaking; and if there be no Smoak (as it muſt happen in abundance of Chimneys, and in all at certain times, or when certain

tain Winds blow) tho' the Aperture for the Exteriour Air be quite ſhut up, 'tis adviſeable to leave it ſo for a while, 'till the Cavities behind the Back are heated. A little Experience in the Affairs relating to theſe Chimneys will give a greater Light into them, than can be done, by a very prolix Diſcourſe on the Subject.

When a great deal of Heat is felt in the Room, and we would not have it encreaſe, yet without being oblig'd to diminiſh the Fire; it is requiſite to ſtop the In-let *R* of the warm Air; and if we would have the Heat abate, the Entry *p d* for the cold Air is to be open'd, and *n m* ſhut: Again, when we are diſpos'd to give the Air that comes in, different Degrees of Heat or Cold; part of thoſe two Entries is to be left open, more or leſs of each, accordingly as we would have the Air more or leſs cold or warm.

Fig. 6, 17, 30, *&c.*

Whenever the Fire is put out, either in the Evening or in the Day, eſpecially if the Weather be very ſharp, care muſt be taken always to ſhut the In-let *D* of the Exteriour Air; otherwiſe the Chamber will ſoon cool: It would alſo be expedient, at leaſt in the Night, to ſtop up the whole Aperture of the fore-part of the Chimney, or when the Fire-brands do not ſmoak any longer, to let down one of the Regiſter-plates, if there be any in the Funnel, to the end, no cold Air from without may enter thro' that Part, as the hot Air is iſſuing forth, or grows cool.

And foraſmuch as the Aperture *R*, which is left for the Exteriour Air to go into the Room, after it has acquir'd Heat in the Cavities, muſt be capable of furniſhing as much Air as will be ſufficient to obſtruct the Courſe of Smoak; all the other Places may be ſhut thro' which any can enter, as well round about Doors as Windows: And to the end that as little Air (as is poſſible) may only get in, as a Perſon is going out of his Chamber, or coming back thither; 'tis adviſeable to have a double Door, one of which muſt be always ſhut before the other is open'd; nevertheleſs this Precaution is only neceſſary in extraordinary Fits of exceſſive cold Weather, tho' it is uſeful at all times, eſpecially during the Winter-Seaſon. Maſtick may alſo be put into the Frames on the out-ſide inſtead of Paper, and there are ſome Artificers who are very dext'rous in performing this piece of Work.

The various Ways of applying theſe Chimneys to other different Uſes are explain'd in ſeveral other Chapters, and therefore there's no need of repeating them here; neither ſhall we inſiſt on the Uſe that may be made of the ſaid

Chimneys in Chymiſtry; ſince it will be ſufficiently apprehended by thoſe Gentlemen who are well skill'd in that Art.

CHAP. III.

Of the Conſtruction of certain Screens, thro' which one may ſee the Fire, and of a pair of Bellows that has a continual Blaſt.

THERE are abundance of People that take great Delight in ſeeing the Fire as they are warming themſelves, and yet cannot endure the burning Heat on their Face, particularly Ladies, and others of the Fair Sex, by reaſon of their delicate Complexion; as alſo all Perſons that have a weak Sight, and many others, upon ſeveral other Accounts.

The ordinary Screens are of good uſe for all theſe Perſons, but do not give them the Satisfaction to ſee the Fire; nevertheleſs it would be an eaſy Matter to oblige them with this Conveniecy: For that purpoſe 'tis only requiſite to have the Screens voided, or fram'd with a Hole in the middle to let in a piece of *Talk* or Iſinglaſs, ſuch as is ſet over *Agnus Dei*'s, and other Relicks, or their Shrines; which will not take away the ſight of the Fire, yet be ſufficient to ſecure one's ſelf from its vehement Heat, and other Grievances; and theſe Screens by that Device will become ſo much the Lighter.

Fig. 37.

* *Talc.*

The ſame Thing may be done to Standing-ſcreens, and ſince one need not be afraid of rend'ring them too heavy, the Aperture may be contriv'd of any Dimenſion, as is judg'd moſt convenient, and clos'd up with a Pannel of Glaſs. Whoever is apprehenſive that this Device will be attended with ſome Inconveniency, may (if he pleaſes) be aſſur'd of the contrary by the Experiment, which is eaſily made.

Thoſe Perſons who are not willing to be at the Charge of a Vent-hole cut in the Hearth of their Chimney, or cannot conveniently fix one in that Place; or that have ſuch a Vent-hole, which at certain times does not give ſufficient Blaſts, eſpecially when they begin to kindle their Fire; may make uſe of theſe Bellows, (the Conſtruction of which we are about to give) to very good Purpoſe.

The Common Bellows blow only by fits, and ſo have but part of the Effect that would be produc'd, if they had a continual Blaſt, as thoſe of Black-ſmiths, Silver-ſmiths, Enamellers, and other Artificers have; but theſe are not made after ſuch a manner as that they can be us'd by holding them with the Hand, and therefore their Conſtruction muſt be ſomewhat vary'd, to render them ſerviceable in that Way.

If

Fig. 38. If then you are desirous to be furnish'd with Bellows that have a continual Blast, and which may be made use of as the ordinary ones are, it is requisite they have three Wings, like those of Silver-Smiths, *&c.* but that the undermost be Immoveable, and the two others Moveable; that these two have each a Clack-hole opening underneath, and a small Spring to keep them shut, when they are not press'd above by the Air; that the Aperture of the Nozzle have a Communication only with the undermost Wing, and that of the Middle; that between those two Wings a Spring be made fast at one Extremity to that of the undermost, and at the other End, to that of the Middle one; that this Spring draw them near one to the other, as is seen in the 38th Figure, that represents the Bellows cut by a Plane, which falls from the Pipe *P*, to the Handle *f*: A B *Fig.* 38. is the undermost Wing, *C D* that of the Middle, *E f* the uppermost Wing; *G h* the Clack-hole of the uppermost Wing, *g L* that of the Middle one, *m*, *n* the Spring which keeps the middle Wing near to the undermost; and *m* the Place thro' which the Air passes from the Bellows into its Pipe *P*, in order to go out at *O*.

The rest of the Parts are not different from Enamellers Bellows, not even from those that are generally us'd at present to blow the Fire in common Chimneys: Hence it may be infer'd, that the Workmen who make the latter, are equally capable to contrive these we are now describing, the Use of which is, that in elevating or depressing the uppermost Wing, they send forth a continual Blast, and have a triple or quadruple Effect, beyond others of the same Size; so as to kindle the Fire a great deal faster. But farther, we may give them any Dimensions and Figure that is judg'd expedient, and even those of the ordinary Bellows that are now commonly in Use. And indeed, they are very neat, and well proportion'd; but the Aperture for the Clack-hole must not be cut in form of a Heart, as in the latter, by reason that being uppermost, it would not be agreeable to the Sight: It may therefore be made of another Figure, some Parts of which are to be left open; For Example, that of a *Flower-de-Luce*; as appears in the 39th Figure, which represents the entire Wing of the upper Part of the Bellows.

Otherwise, the middle Wing may be made unmoveable, and and the undermost moveable, and in that case it is more expedient to set the Handle *B* on the middle Wing: The Clack-hole may also be cut in the undermost Wing, or else in blowing, the Wing *E f* may be turn'd underneath.

To conclude, these Bellows may be apply'd to other Uses besides blowing

blowing the Fire; they may ſerve for Muſical Wind-Inſtruments, as *Pſalteries*, *Bag-pipes*, &c; they would alſo be very convenient, and ſerviceable for *Anatomiſts*, &c.

CHAP. IV.

Of the Choice of Wood proper for Fuel.

THERE is no Wood that does not raiſe a Fire in theſe New-invented Chimneys; the thickeſt and the greeneſt burn therein without the trouble of Blowing; but all ſorts of Wood in burning do not afford an equal degree of Heat.

It is already well known, that cut Timber which has been ſent down floating for ſome time upon a River, affords leſs Heat, and burns faſter than new Wood does; that Float-beech, call'd at *Paris*, *Traverſe-Wood*, or *Bakers-Wood*, waſtes away ſooner than other Sorts; that green Wood, if it be not well ſurrounded with Flame, burns with greater difficulty than dry, often grows black in the Fire, makes a great deal of Smoak, and is very hard to kindle; and that white Wood, as *Poplar*, *Birch*, *Aſp*, &c. is the worſt of all for burning: But perhaps it has not been as yet taken notice of, That in a Pile of Wood newly cut down, tho' dry, ſome parts thereof give more Heat and burn clearer even beyond Compariſon, than the others.

Oak-wood, which (as I take it) is moſt of all made uſe of for Fuel in *France*, burns and heats well while it is young; but when old, it blackens in the Fire, its Embers flying off in Scales, affords no Heat, and ſoon dies out: So that in the chuſing of *Oak*, the round Billets of three or four Inches Diameter are to be preferr'd before thick Logs cut into Quarters.

Pelard-wood, i. e. *Oak*, the Bark of which has been cut off for the Uſe of Tanners, burns very well, yet affords but very little Heat; as I have often found by Experience.

The *Yoak-Elm*, or *Horn-beam*, burns well, makes a very good Fire, and yields abundance of very hot Embers, which laſt a long time; but there is not any Wood purely of that *Species* now to be met with in the Timber-Merchants Yards.

The beſt Wood then that can be burnt, that makes the moſt agreeable Fire, and that recommends it ſelf upon account of its Conveniency in other reſpects, at leaſt at *Paris*, and I am apt to believe in many other Places, is young or freſh *Beech*; for it raiſes a very good clear Fire, with little Smoak, when 'tis well ſet in order, gives a great deal of Heat, and makes a no leſs Quantity of Embers.

It is not indeed always in our Power to pick out ſuch Wood as we like beſt, we muſt content our

our ſelves with taking and applying to our Uſe, that which is found in the Places where we have our Abode; but 'tis adviſeable to know which ought to be made Choice of, when we meet with ſeveral Sorts: I mean thoſe different kinds of Wood, the Knowledge whereof I have gain'd by Experience in the ordinary uſe of them. Thoſe Perſons who are inclin'd to make ſuch Remarks with greater Application, may be in a Capacity to furniſh Matter for other Improvements and Additions to this Chapter.

The CONCLUSION *of this Treatiſe.*

IF the Conveniencies and Benefits which may redound from theſe new-invented Chimneys, would render the Uſe of them commmon, and cauſe due Notice to be taken, That Men of the brighteſt Parts, have not chiefly apply'd themſelves to the Study of, nor even ſufficiently conſider'd Things that are moſt Uſeful and Neceſſary: And in caſe this Reflection ſhould engage ſome of them to leave thoſe Sublime Speculations and Ingenious Machines, which are only pure Matters of Curioſity, in order to eſtabliſh the ſimple, but more beneficial Principles of Mechanicks; this Treatiſe would then have all the Advantages we have propos'd to our ſelves in ſetting it forth to the Publick.

FINIS.

AN EXPLICATION

Of the FIGURES.

THE Figures, 1, 2, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 25, 26, 34, 37, 38 and 39 need no other Explications, than those that are given in the Chapters in which they are respectively mention'd.

FIGURE III, represents the Profil of a Chimney cut by a Plane perpendicular to the Hearth, and to the Back.

Z, Is the Trap-Door of the Vent-hole; *X* its Aperture, when it sends forth Blasts.

F, The Place where the Fire is.

T t, The Ash-hole, and below it, the Cavity that ranges under the Hearth.

S G A, The Cavity behind the Back-part of the Chimney.

o i m, The Horizontal lower Plane of the Concave, such as we require it to be.

I, The Canal that is under the Chimney-piece.

m L N R, The Tunnel of the Chimney.

o R, The Line which marks the *Talus* or Slope of the Breast, when there is one, and that the whole Space *o m R* is void, as in the ordinary Chimneys.

FIGURE VI, represents an entire Chimney, whose Jambs or Sides are Parabolical.

A H C c b a, Is the Hearth of the Chimney.

Z, The Vent-hole with its Frame.

K T t k, The Ash-hole.

O D F I L, the proper Back of the Chimney, with its Frame, made of a thick strong Plate, and set before the great thin Plate of the back-part to hinder the Wood from burning in it, when there is a Cavity made behind for the Passage of the Air.

D d, The sliding Doors thro' which the Air may enter the Cavities, when there are any.

R r, The Doors of the Apertures, thro' which the Air is to go out.

g l, The small Needle that causes the Cylinder or the Spindle to turn about, which is to shut and open the Passage for the Air.

FIGURE

Plate 1.

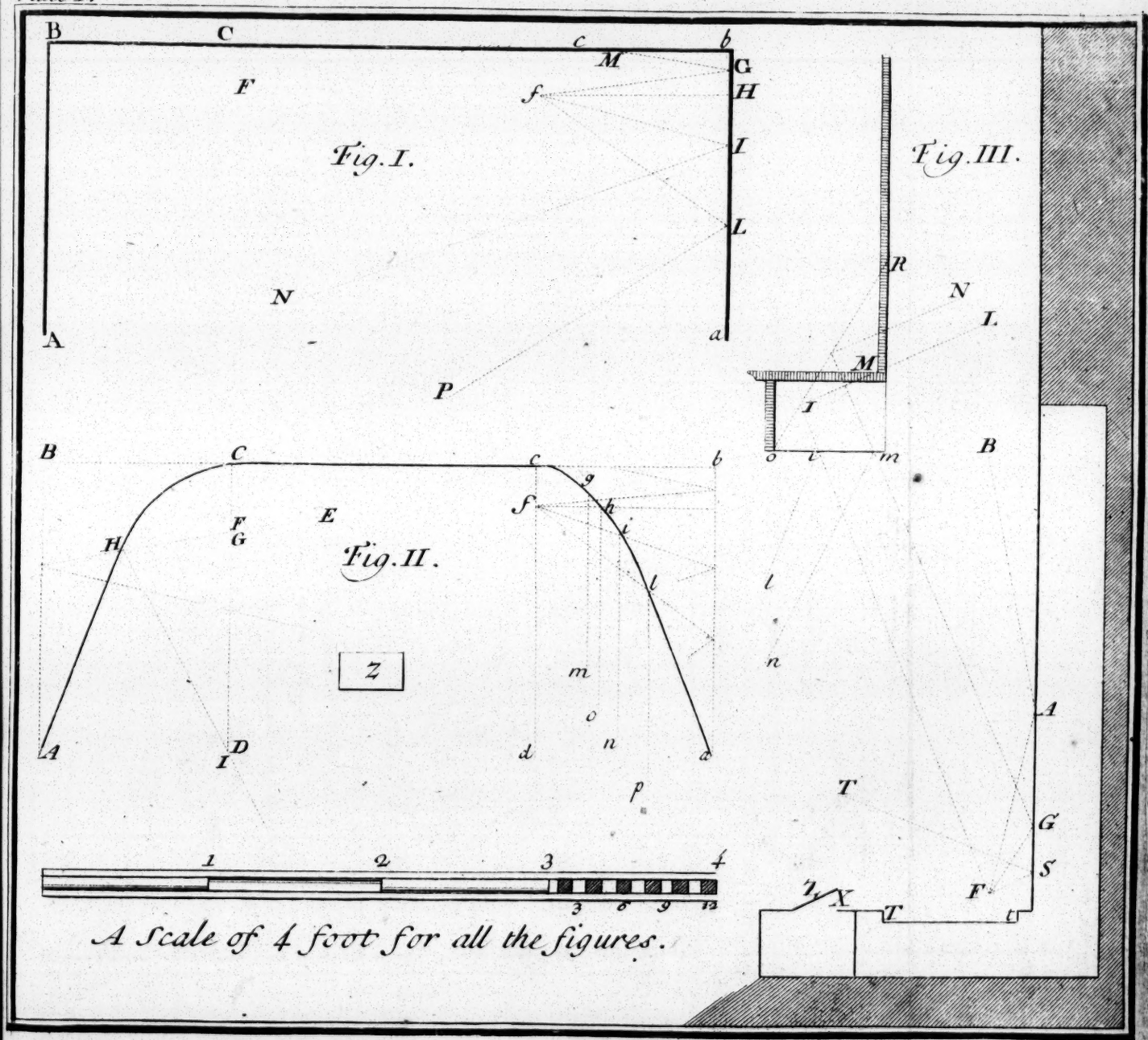
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Fig. I.
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A Scale of 4 foot for all the figures.

Plate 2.

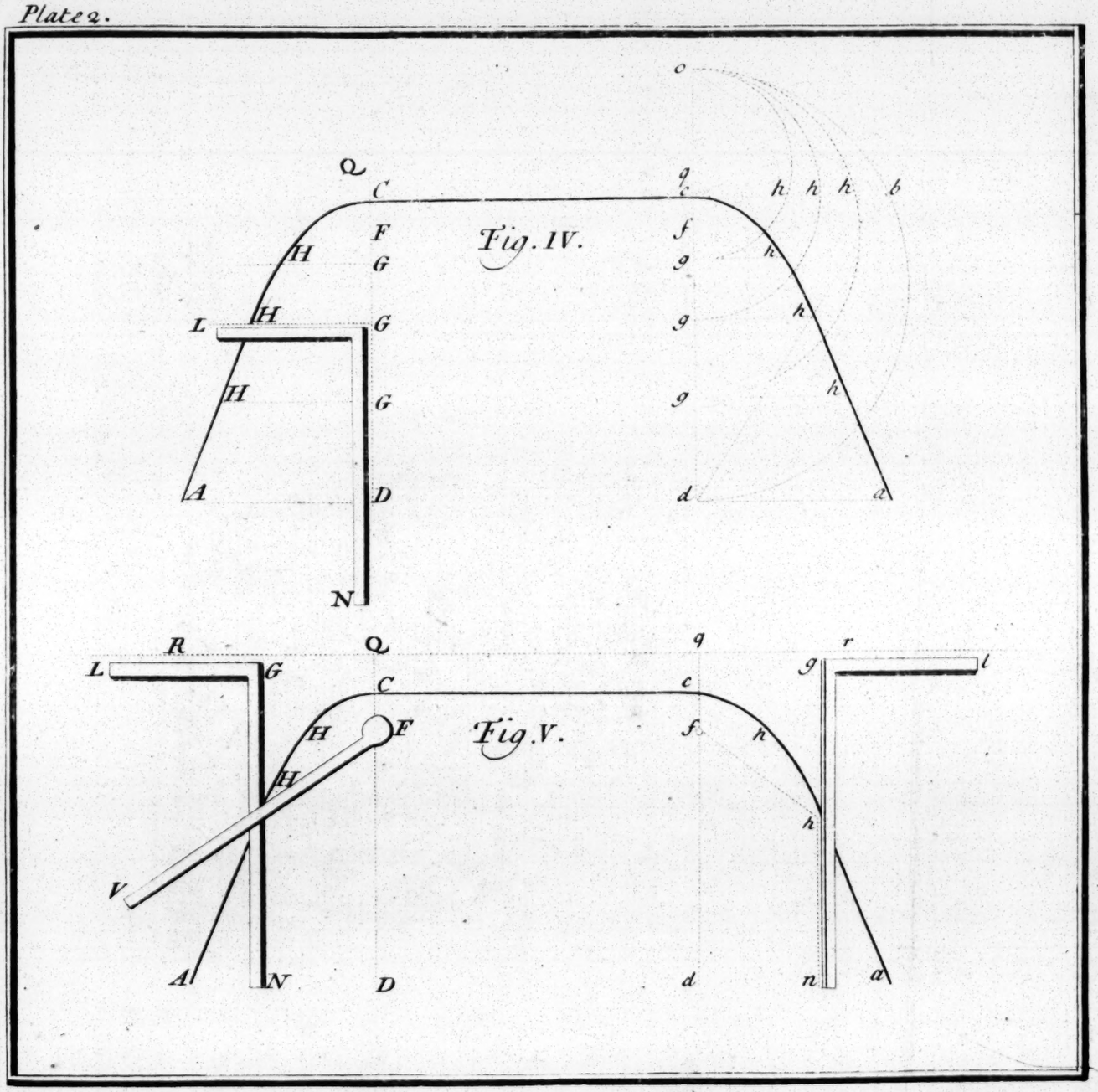
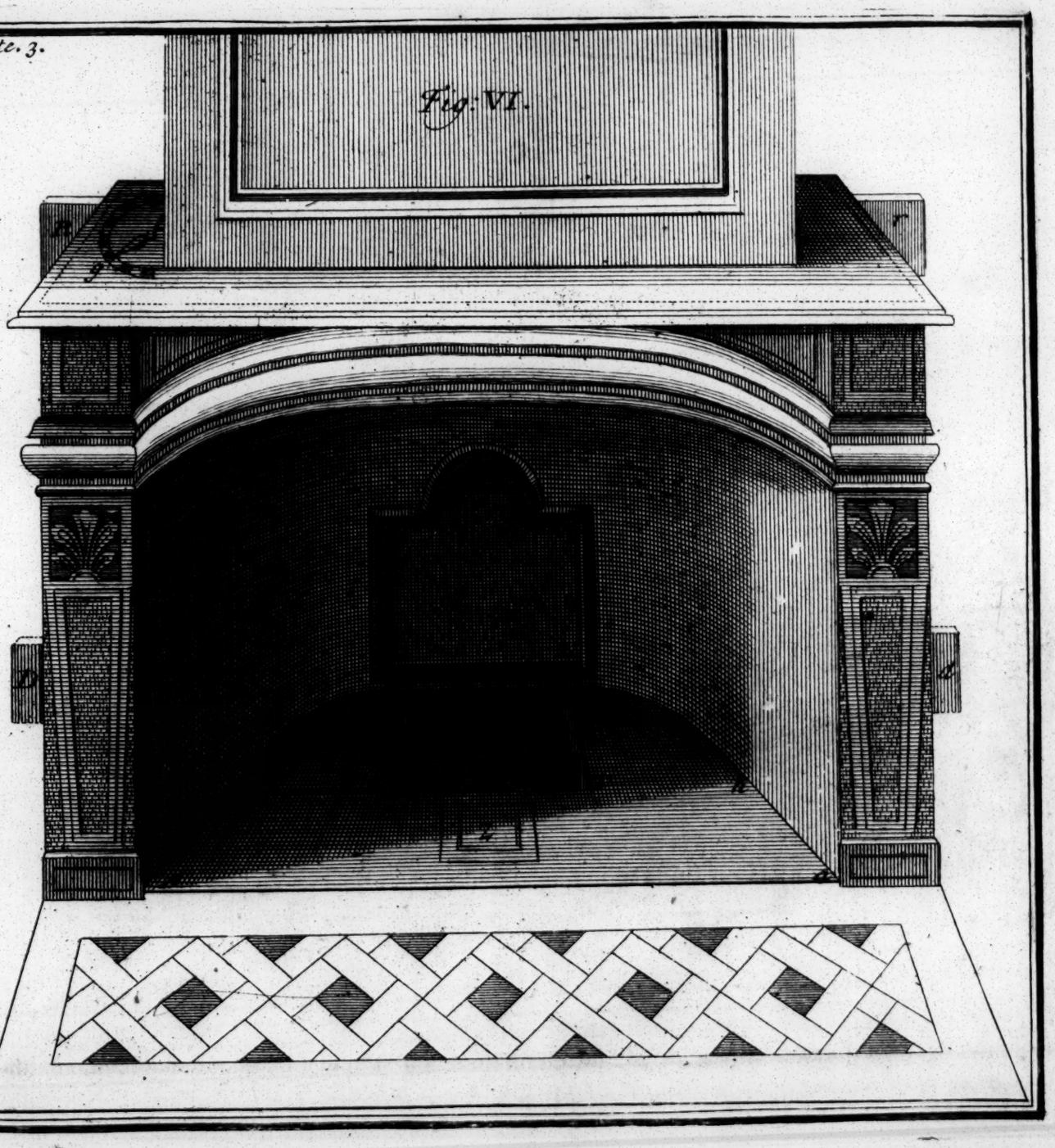


Fig. IV.

Fig. V.

Plate. 3.

Fig. VI.



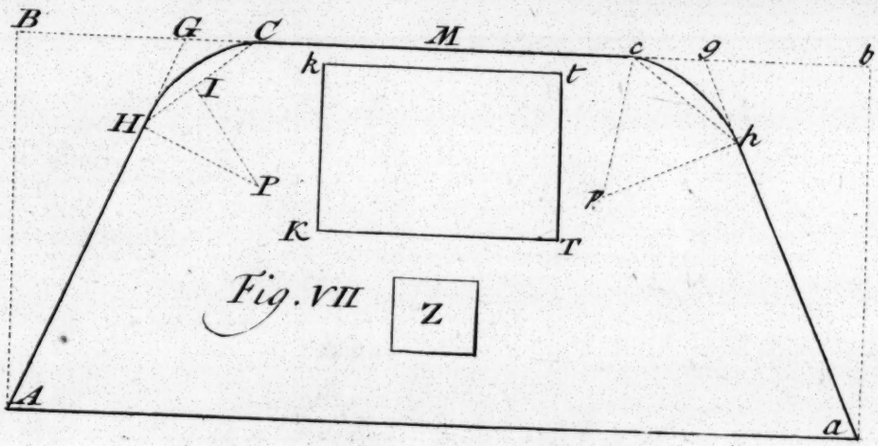


Fig. VII

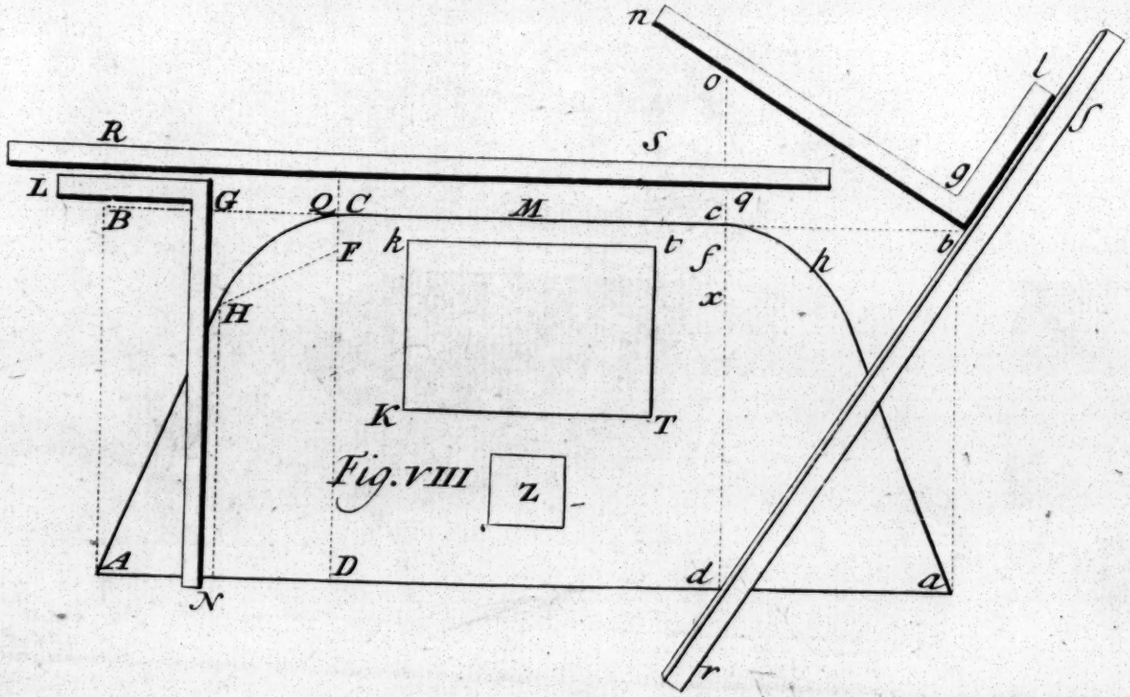


Fig. VIII

Plate 5.

Fig. XI.

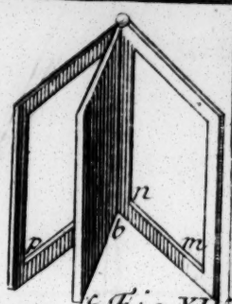
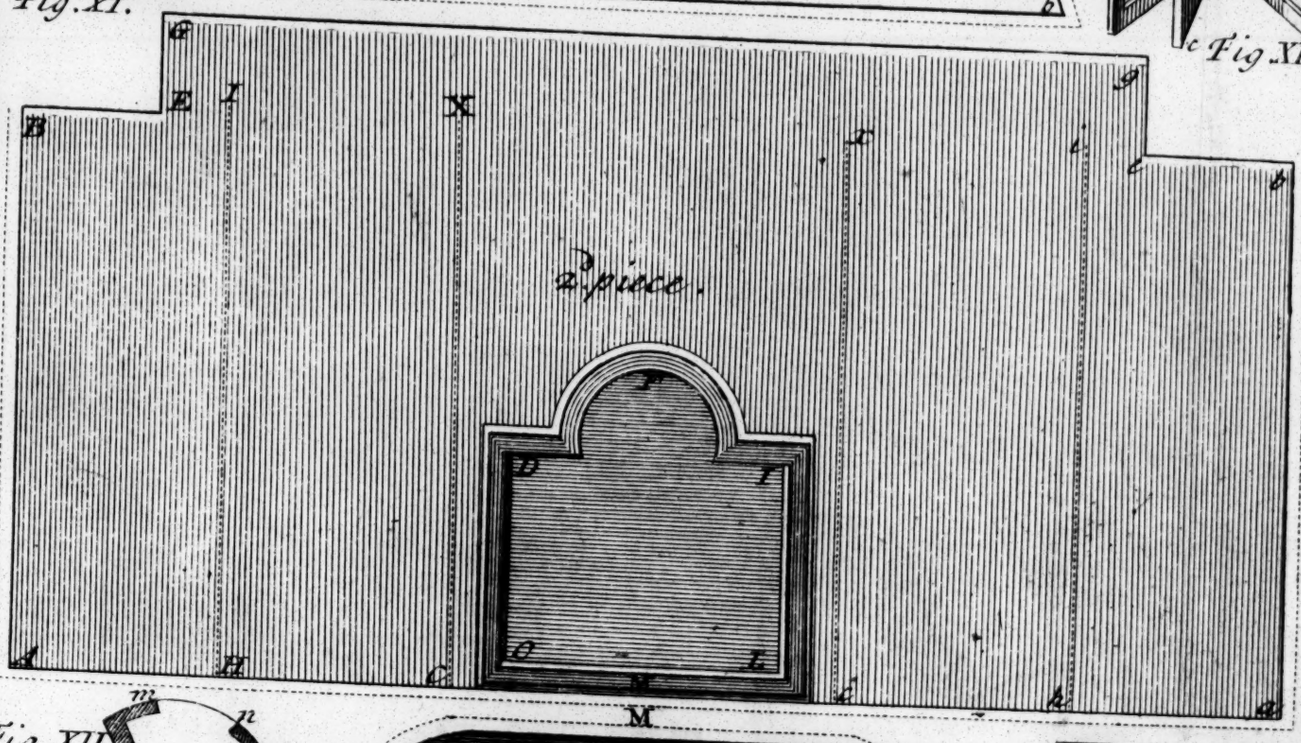


Fig. XII.



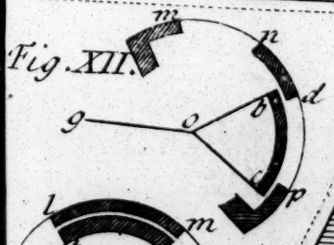


Fig. X.

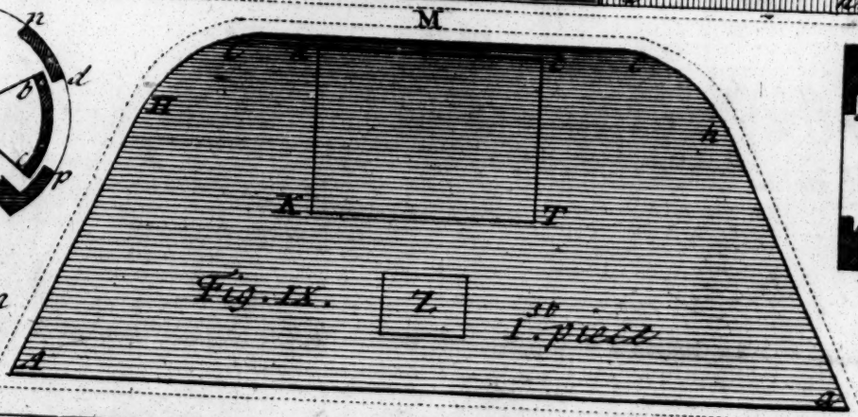
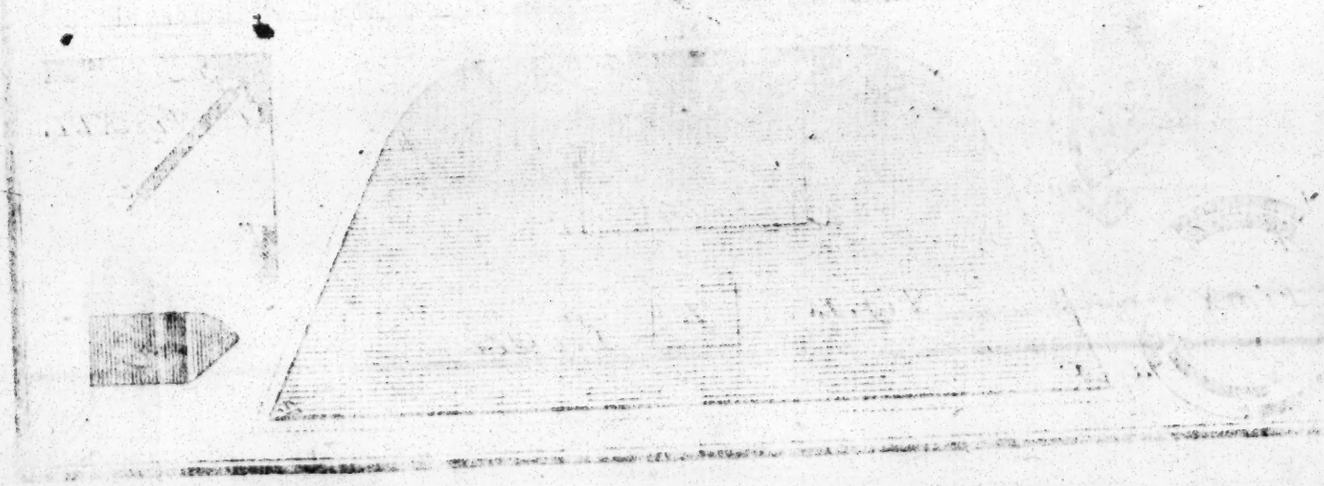
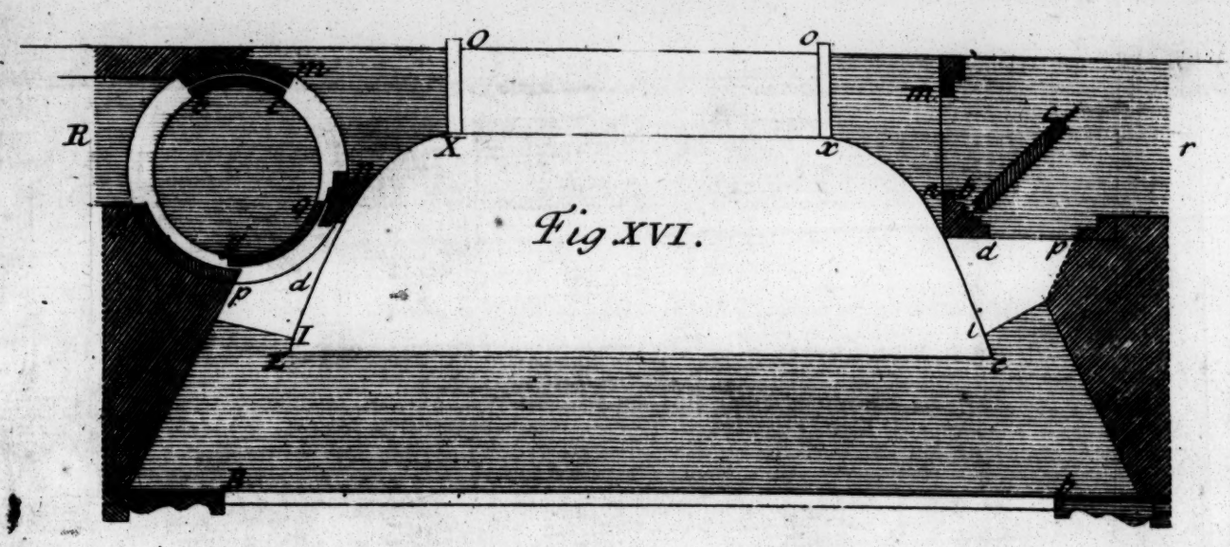


Fig. IX. 1.st piece

Fig. XIII.





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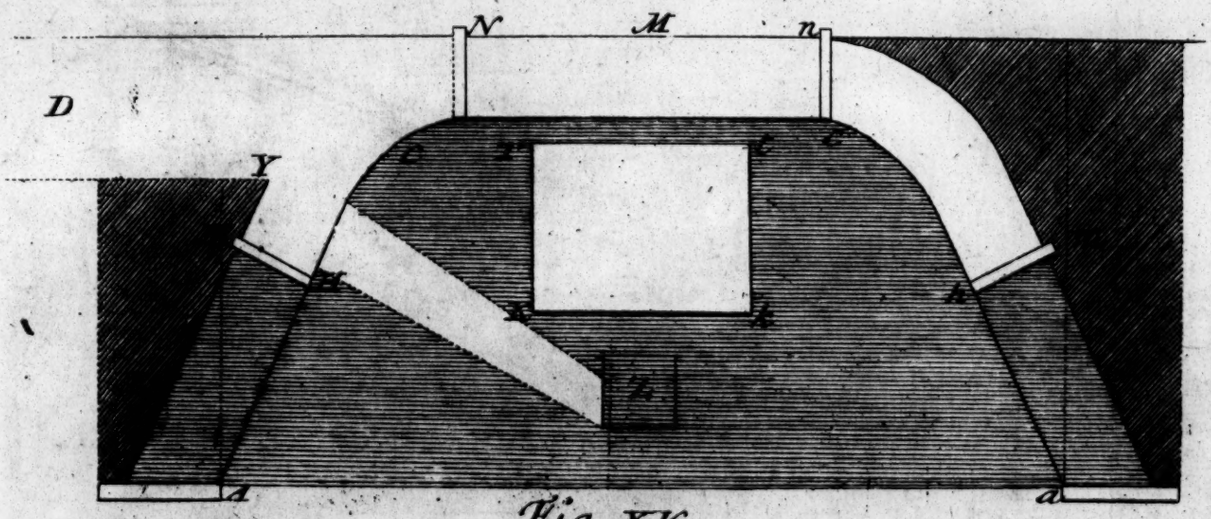

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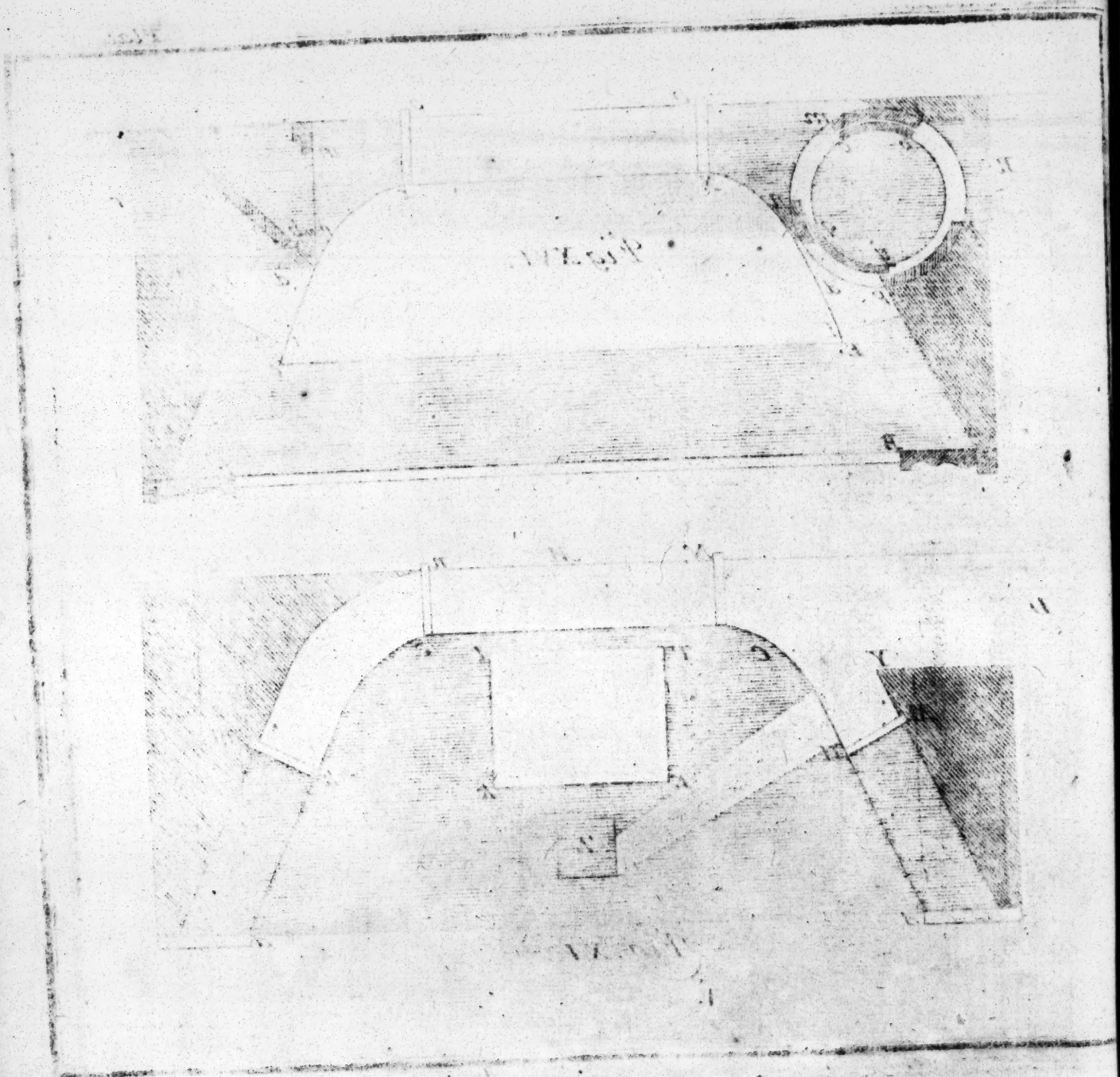

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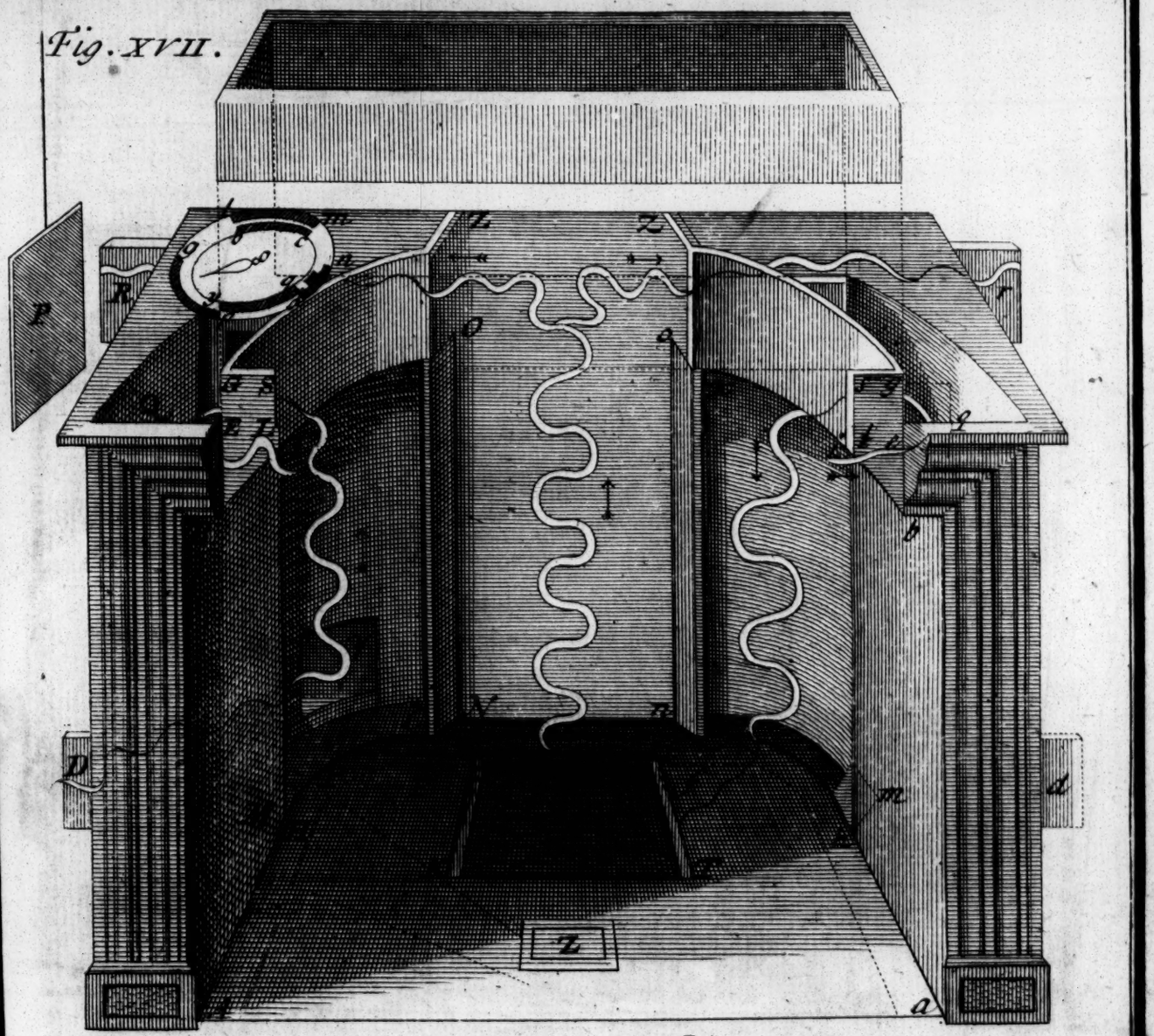
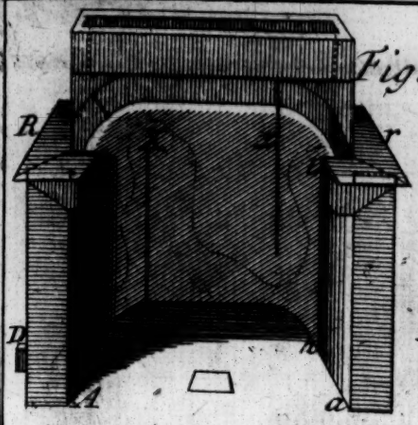



R
D
R
D

Plate 8.

Fig. 18



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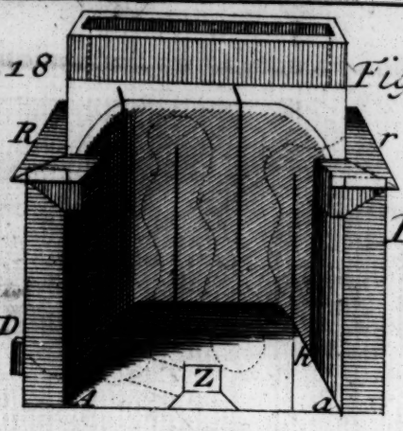
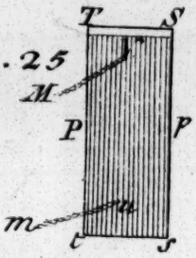
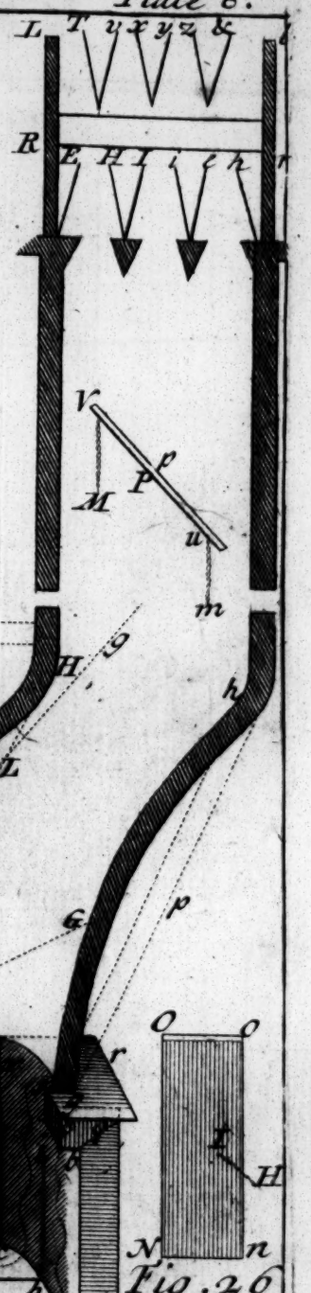


Fig. 25





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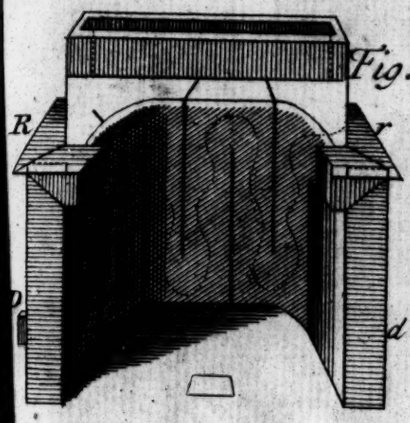


Fig. 21.

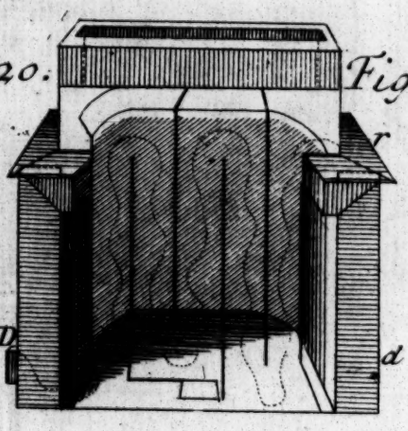
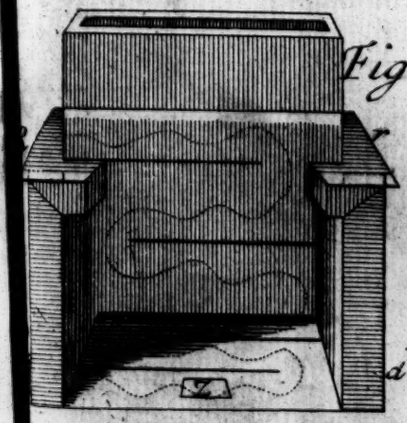


Fig. 24

Fig. 22



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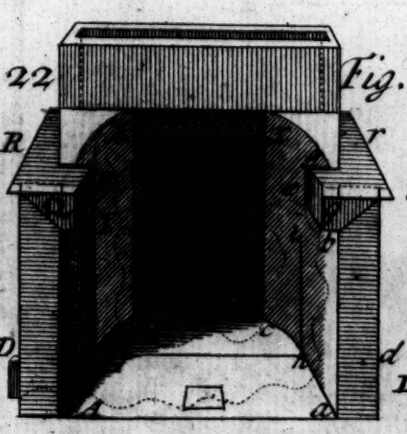


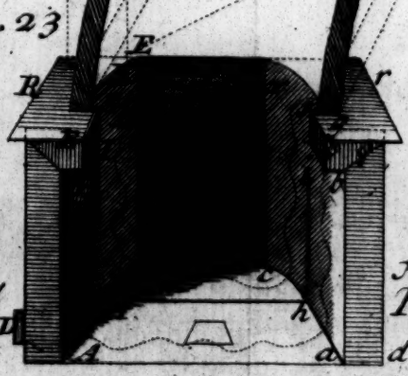
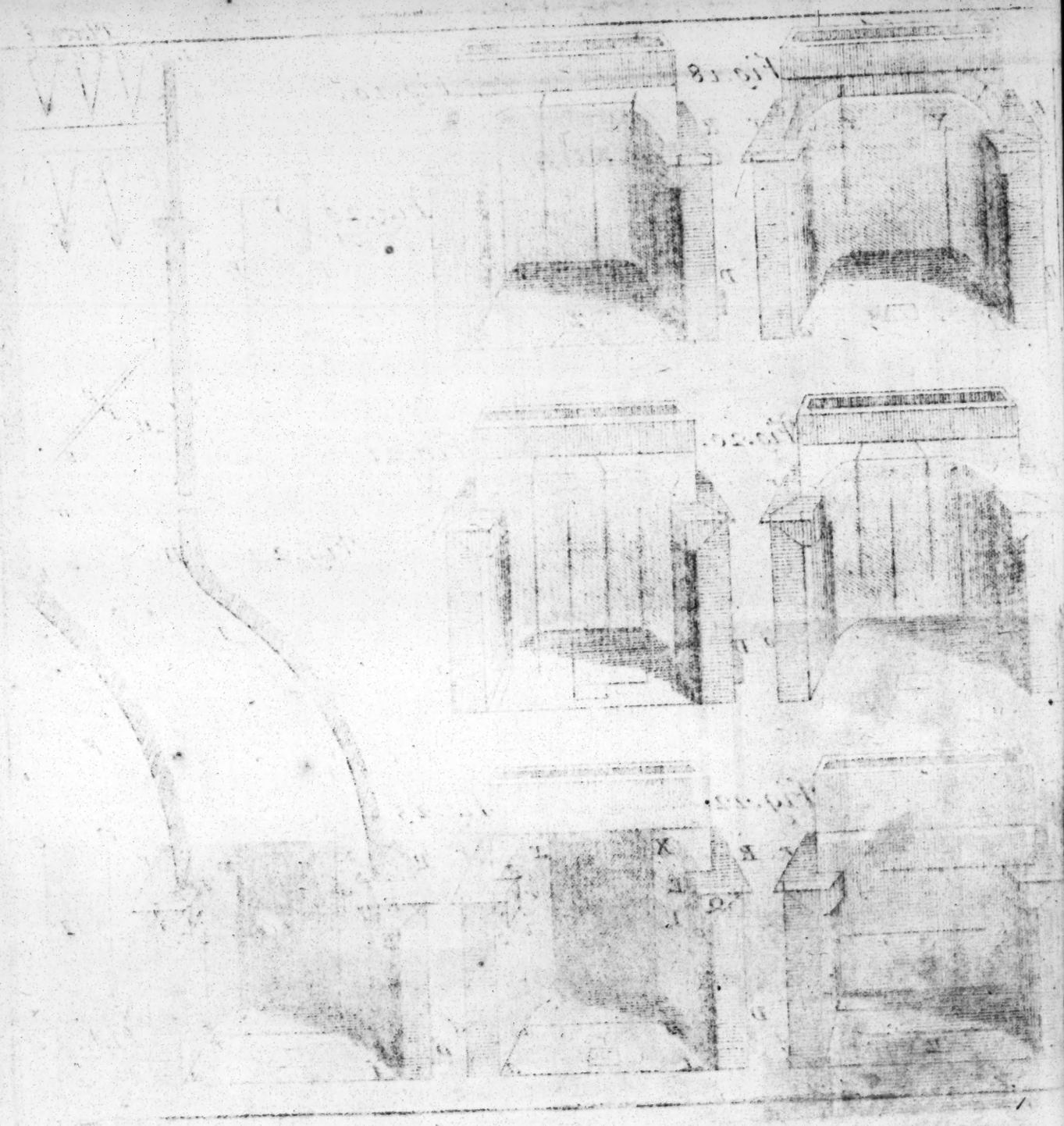


Fig. 26



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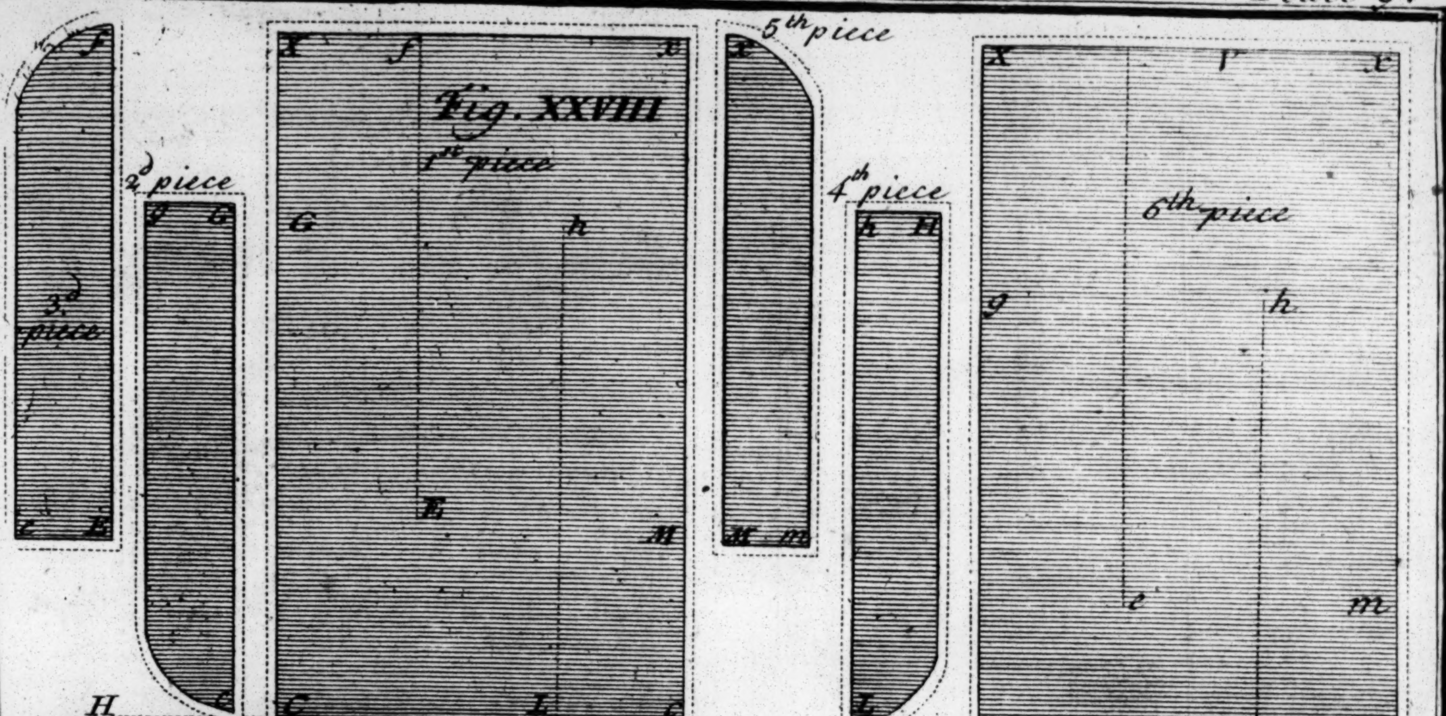
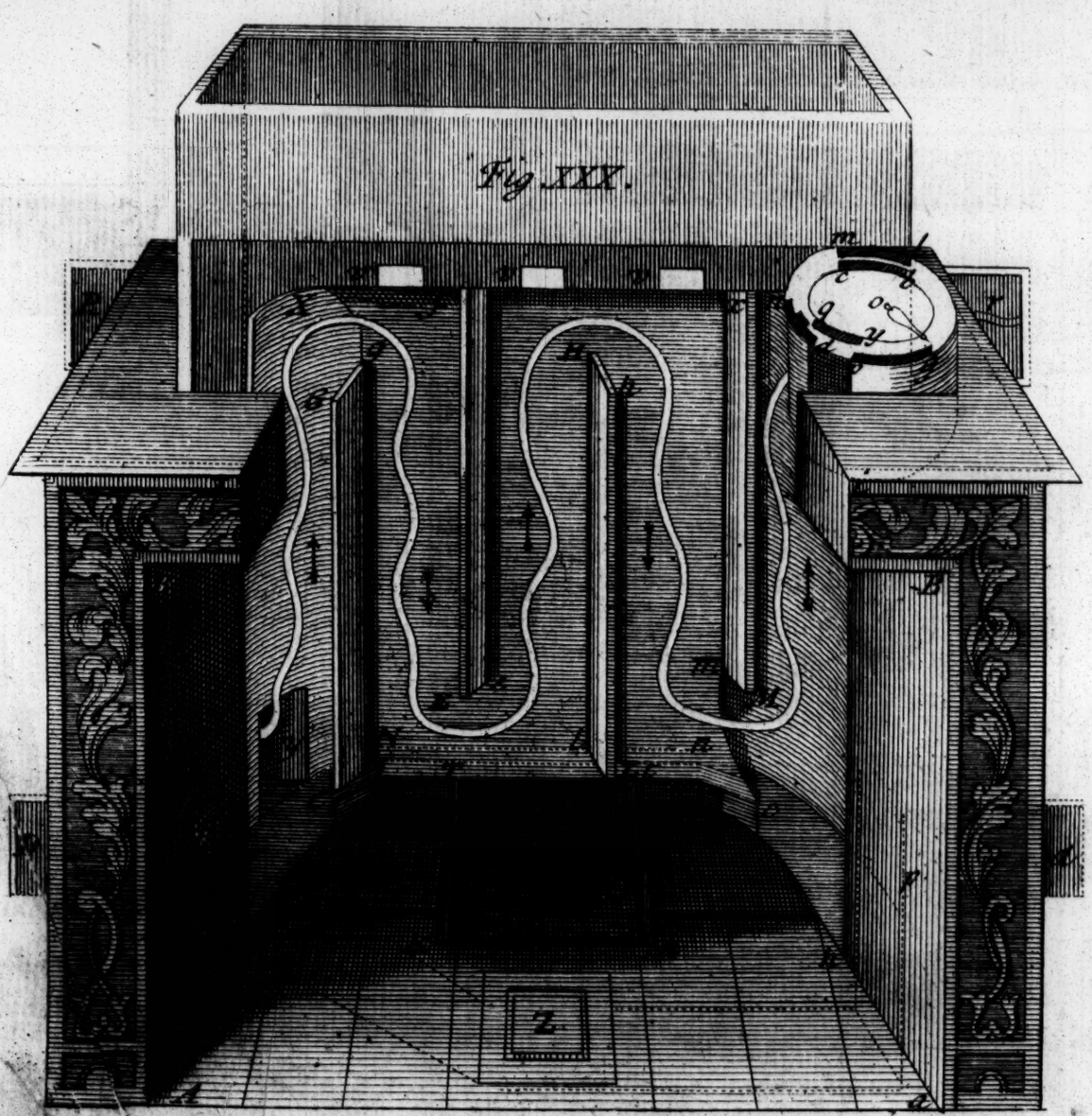
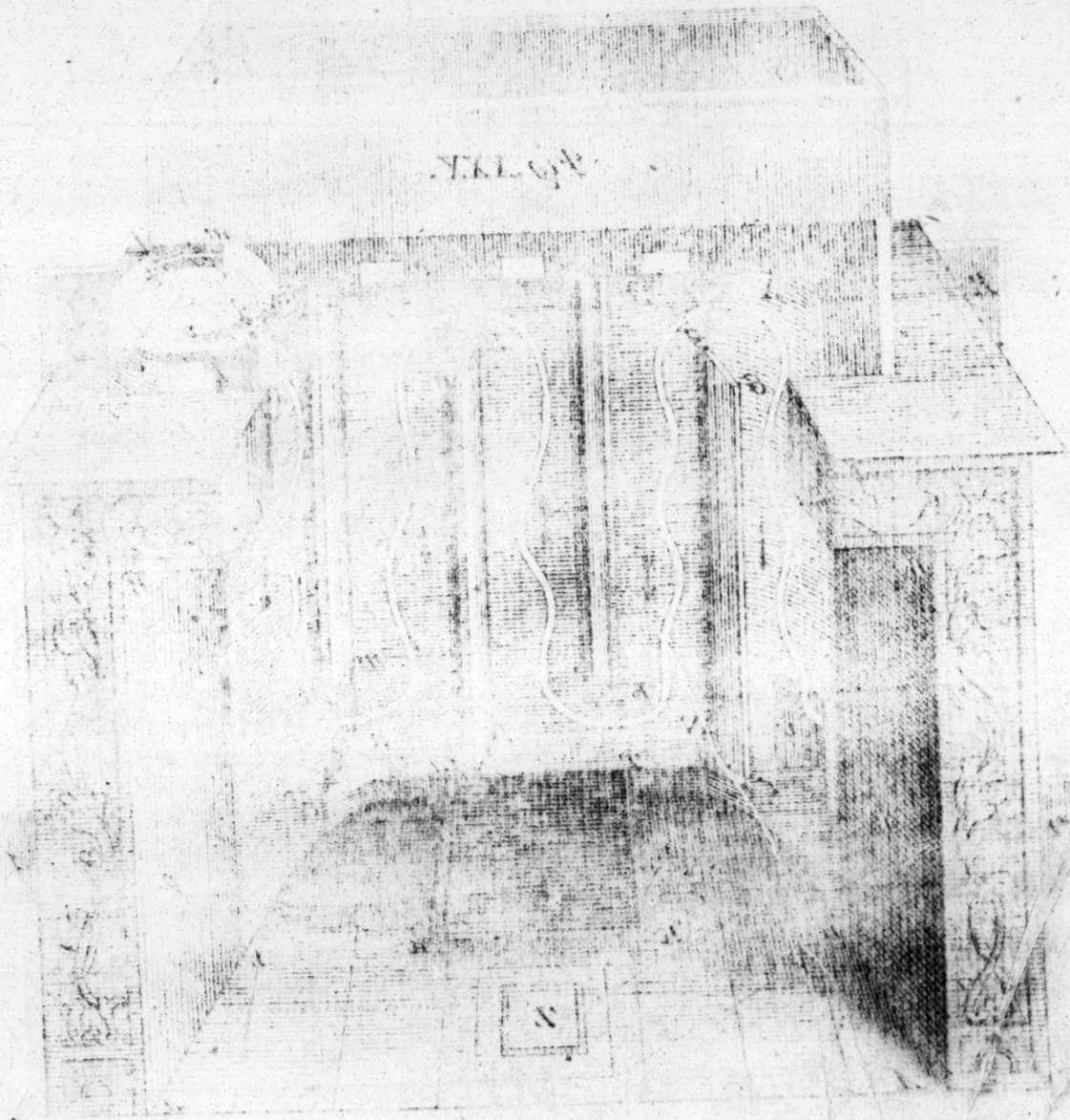
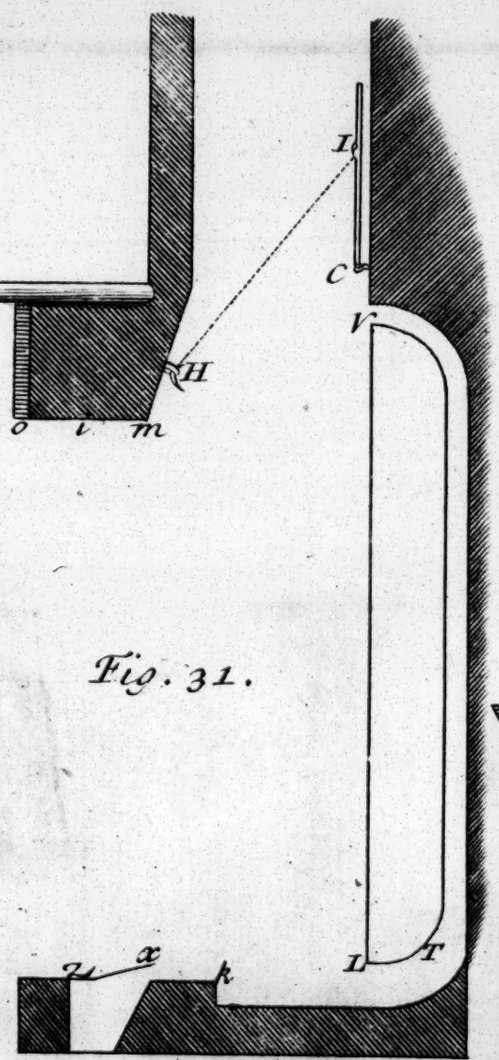


Fig. XXVIII
1st piece
2d piece
3d piece
4th piece
5th piece
6th piece
Fig. XXIX.

Fig XX.







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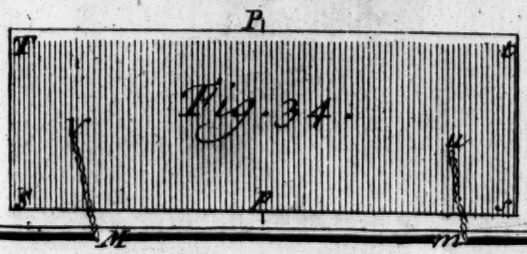


Fig. 34.

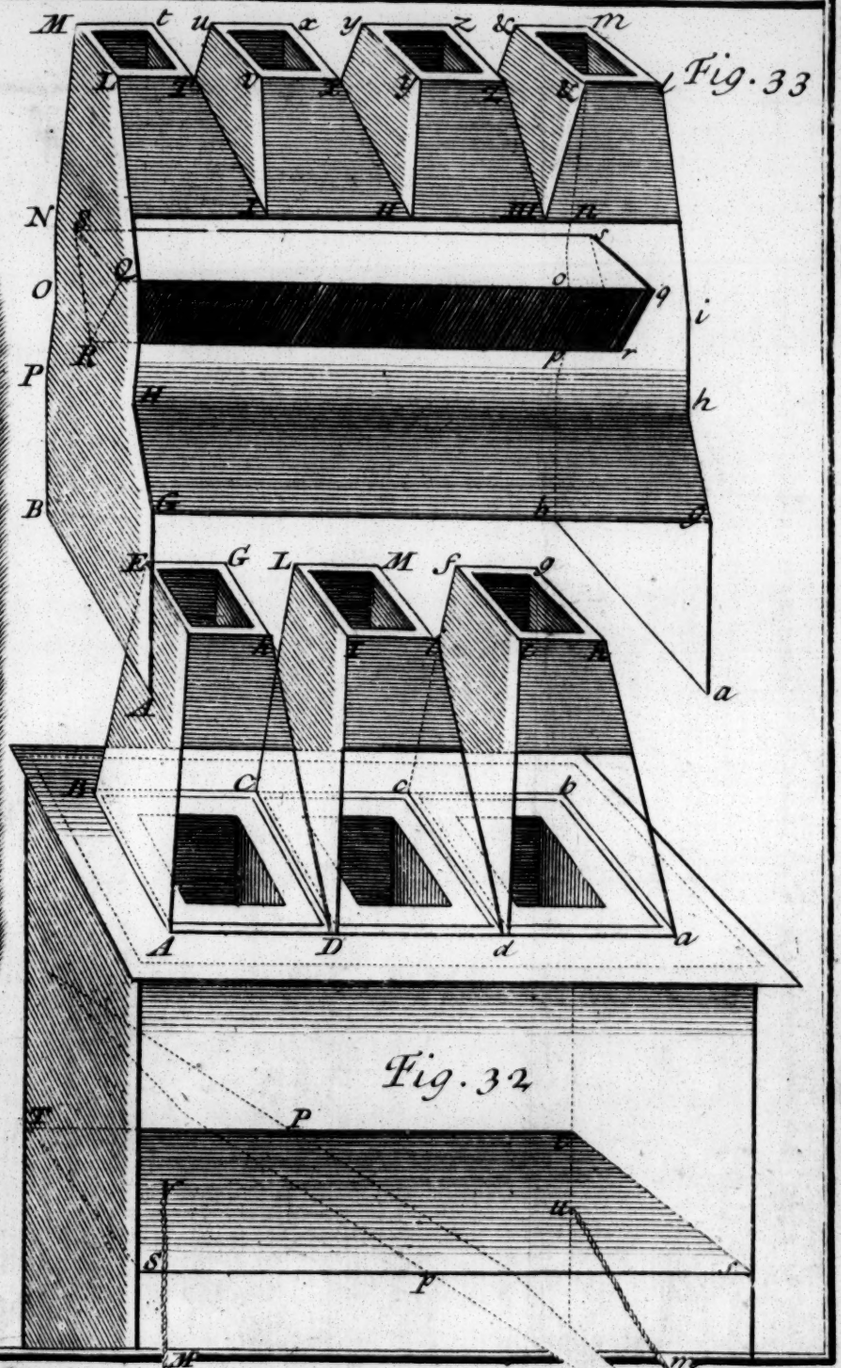


Fig. 33

Fig. 32

Plate 12.

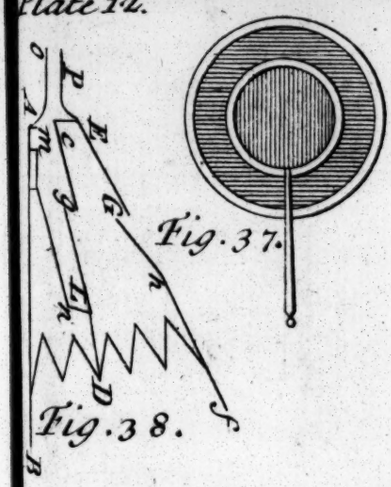
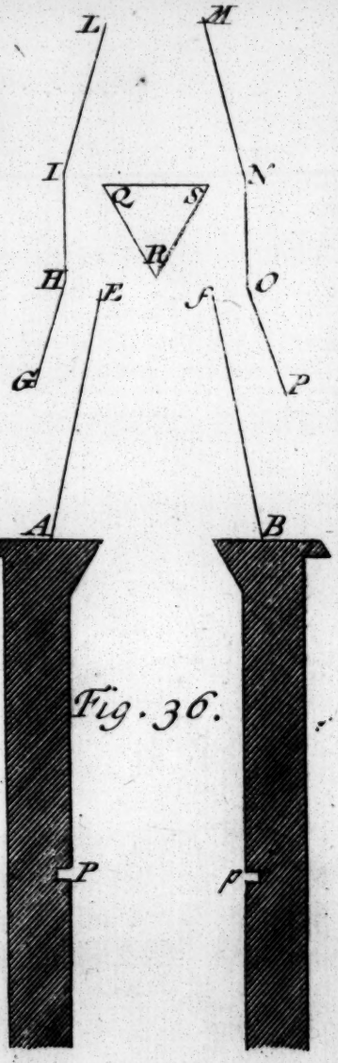


Fig. 37.

Fig. 38.



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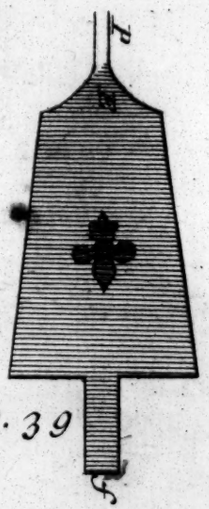
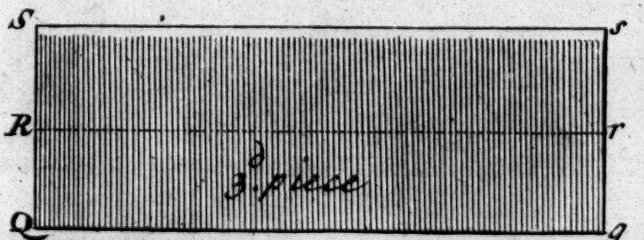
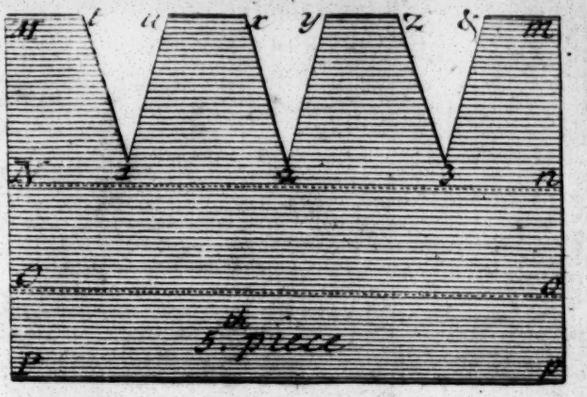


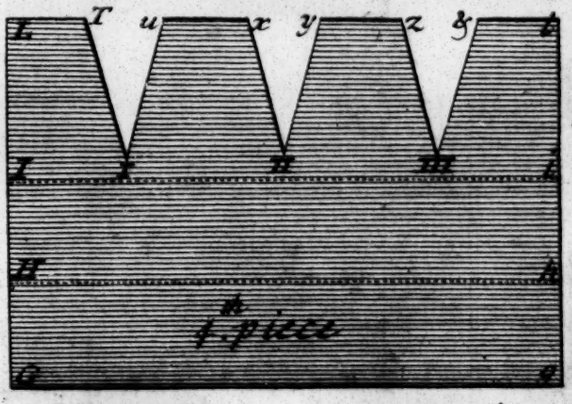
Fig. 39



3d piece



5th piece



4th piece

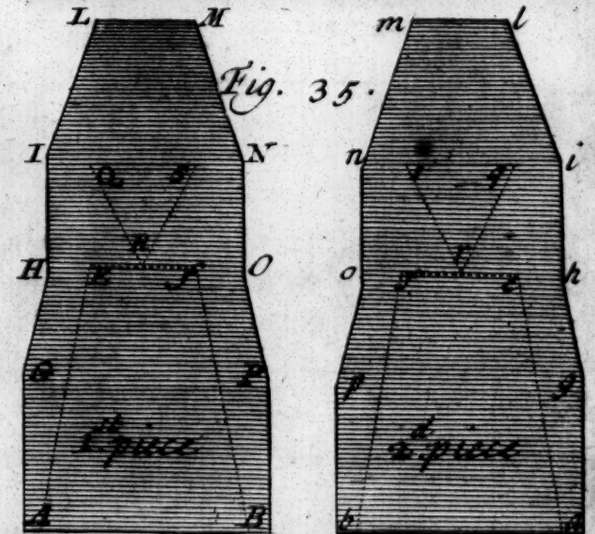


Fig. 35.

1st piece

2d piece

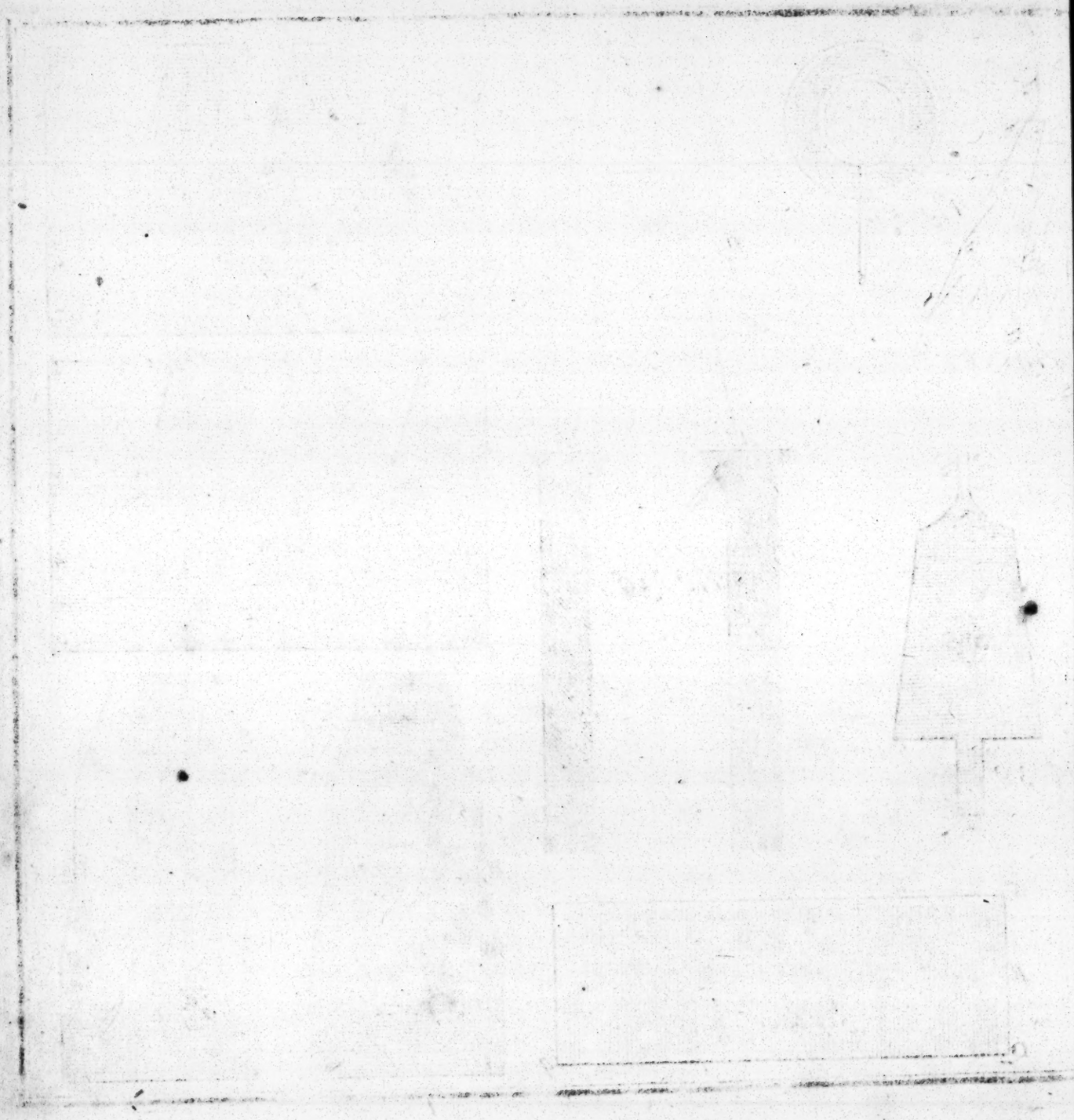


FIGURE XV. Is the Geometrical Plan of the fourth Conſtruction of a Chimney, which is repreſented in the 17th Figure.

A H C c h a, Is the Hearth.

Z, The Cavity under the Vent-hole.

H Z, The Canal which conveys the Air thereto.

K T t k, the Aſh-hole.

H M, *C N*, *c n*, *h m*, the bottom of the Bands or Partition-Plates that ſeparate the Cells.

H M C N, *C N*, *n c m h*, The *Baſes* of the three Cavities, behind the Sides, and Back-part of the Chimney.

D Y, The Conduit thro' which the Exteriour Air enters the firſt Cavity.

FIGURE XVI. Is another Plan of the ſame Chimney, cut Horizontally and directly below the Traverſe of the *Chambranle*, or Mantle-piece.

B b, Is the Extremity at the bottom of the Traverſe or Croſs-piece of the Mantle-tree.

B E e b, The lower Part of the Canal, that is under the Concave.

E X x e, The lower Aperture of the Funnel of the Chimney.

d p I, the Place thro' which the Air riſes up in the Canal.

d p i, The Place thro' which it goes down.

X O o x, The upper Part of the Cavity, thro' which it riſes behind the Back-part of the Chimney.

X O M, *x o m*, The lower Part of the Conduits, thro' which it iſſues out, to get into the Chamber.

m n l g, The *Baſis* of the Cylinders or Barrels, thro' which the Air paſſes.

m n p, The double Square, that produces on the other Side, the ſame effect as the Cylinders do.

X O, *x o*, the Top of the Bands, or Partition-plates.

This Plan being ſet over that of the 15th Figure, repreſents the Chimney as it is, and the 17th Figure, as it appears to be.

FIGURE XVII. Shews the fourth Conſtruction of a Chimney, the Back-plate of which is taken away from *H I*, to *h i*, in order to diſcover the Bands, and the Conduits they form behind the Plate, and the Courſe the Air takes therein. The Traverſe of the Mantle-piece is likewiſe taken away from *B* to *b*, as well as the Concave, and the whole Canal which is to fill up that Space, to the end we may clearly diſcern the Back-part and In-ſide of the Chimney, after what manner, and thro' what Places the Air in thoſe Parts, riſes upward, goes down, and iſſues out.

A H C c h a, is the Hearth, which is hollow underneath.

Z, The Vent-hole.

K T t k, The Aſh-hole.

A B I H, *a b i h*, Part of each Jamb.

H I X C, *C X x c*, *c x i h*, The three Cells of the Back-part and Sides uncover'd.

XONC, xonc, The two Bands that make the Partitions of those three Cells.

BESL, besl, The two cut Planes of the Canal.

l m n g, The upper Part of the Cylinder.

m n, The Aperture thro' which the hot Air enters; *p d,* that thro' which the cold Air comes in; *g l,* that thro' which it goes out, in order to pass into the Chamber thro' *R.*

P, A Leaf of Paper hanging by a Thread, before the Aperture *R.*

D, The Aperture thro' which the Air enters the first Cavity.

Lastly, The Line which goes winding about from *D* to *R* and *r,* shews the Route and Passage of the Air in the Cavities of this Chimney; the Point of the small Arrows discovers, where it ascends or descends, or on what Side it proceeds: So then that which is under *I,* lets us see that the Air issues out in that part of the Canal, to joyn the other Aperture at *i*; where the little Arrow likewise makes it appear, that the Air gets in again in that Place, to go out between *g* and *q,* to slip down again thro' the Cell *i x c,* to pass under the Hearth, and to rise up again in the middle Cavity; to issue out afterwards, either on the Left, or on both Sides at the same time, in order to enter the Room.

The Lines which go turning in and out in the Figures 18, 19, 20, 21, 22, 23, 24. in like manner shew more distinctly this Course of the Air. But it is to be observ'd, that the Dimension of these Figures is but a Third Part of the others.

The Upper Part of FIGURE XXIV, is a Profil of the Funnel or Shaft of the Chimney, of the Pyramids, and Capital, that are on the Top, and of the Register-plate on the Inside, cut by a Plane in the Length of the Capital.

FIGURE XXVII, Represents the Chest or Box for the fifth Construction, the Fore-part of which is taken away, to shew the Cavities and Bands on the Inside, and the Route the Air takes therein.

In FIGURE XXVIII, Are seen all the Pieces of that Chest.

FIGURE XXIX. Is the Geometrical Plan of the fifth Construction of a Chimney.

A H C c h a, Is the Hearth which is not hollow underneath.

Z, The Vent-hole.

H Z, The Canal that conveys the Air thither.

C N n c, The Cavity wherein the Box is to be set. The Distance between the Line *N C,* and the Line pointed with Pricks marks the Space, that is to be allow'd behind the Box when it is laid and settled.

H P N C, h p n c, Are the Bases of the two last Cells, when there are Five in Number.

FIGURE XXX. Represents the fifth Construction of a Chimney form'd and fixt in its proper Place,

Place, after having taken off the the Fore-part of the Back from *H* to *h*, the Middle of the Traverſe of the Mantle-piece, and of the Concave, and the *Baſis* of the Fore-part of the Funnel, to ſhew the entire Back of the Chimney, or the Inſide of the Cheſt, and the Route of the Air.

A HC c h a, Is the Hearth.

Z, The Vent-hole, with its Frame.

H Z, The Canal, thro' which the Air paſſes into it.

Z a h p, The Canal that conveys the Air to the Cylinder.

C Gg, *F E c*, *H h l*, *x m M*, The Bands faſten'd to the Back-part of the Cheſt.

The Line *C T t c*, Shews the Elevation of the Cheſt above the Hearth, and the prick'd Line beyond it marks the Space that is to be left behind the Cheſt; and which gives Light for the better apprehending of Figure 21.

V, *V*, *V*, The Apertures thro' which the Air iſſues out, and the Heat that paſſes behind the Cheſt.

The Line that goes winding about diſcovers the Courſe the Air takes when there are five Cells.

g l m n, Is the Cylinder thro' which the Air enters the Chamber: This Device may be ſet on the other Side, as that of the 17th Figure is.

FIGURE XXXI, Is the Figure of this fifth Conſtruction of a Chimney, cut by a Plane perpendicular to the Hearth and to the Back.

Z, Is the Vent-hole; × its Aperture.

K T, The Aſh-hole.

L T U, The Breadth of the Cheſt or Box, behind which is ſeen the Space that is to be left, in that Part.

I C, The Iron-bar that is to be fixt at the entrance of the Funnel of the Chimney; *H G* the Hook and Rod which ſerve to bear it up.

o i m, the lower Horizontal Part of the Concave.

FIGURE XXXII. Repreſents the Top of the Funnel, or Shaft, with its three Pyramids above, the entire lower Part of which is left uncover'd, to ſhew the Apertures of the ſaid Funnel.

T t s S, Is the Regiſter-plate, to be fixt in this Place in order to quench any Fire that breaks out in the Chimney; *P p* are the *Pivots* or Tampins on which the ſaid Plate is to turn; *V M*, *u m*, the Wires that ſerve to open and ſhut the ſame; it is here repreſented ſhut, but the Pointed Lines make a Repreſentation thereof partly open. The fore-part of the Funnel is left uncover'd, in order to afford a clear View of this Device.

FIGURE XXXIII. Is the Capital, which 'tis ſometimes neceſſary to place over the three Pyramids: It ought to be fixt after ſuch a manner as to bear on the Top of the Funnel of the Chimney; that is to ſay, *A B* of the Capital lying upon

A B of the Funnel, and *a b* of the former upon *a b* of the latter; and ſo as the Surface *H G g h* may cover part of the Pyramids, and the Line *R r* fall on the Middle of the Apertures of thoſe Pyramids.

FIGURE XXXV. Repreſents all the Pieces of this Capital ſeparate one from another.

FIGURE XXXVI, Is a Profil of the Top of the Chimney-ſhaft, of the Pyramids, and of the Capital, cut by a Plane perpendicular to the breadth of the Funnel.

P p Are the Holes thro' which the Tampins of the Regiſter-plate are to be let in.

A E F B, Is one of the Pyramids.

Q R S, The cut Plane of the Triangular Priſm that is above it.

G H I L M N O P, The Section of the Capital that covers them.

In this Profil any one may ſenſibly diſcern with what eaſe the Smoak iſſues out of the Chimney, and the difficulty the Wind meets with in getting into it.

The End of the Explication of the Figures.

The

The Contents of the Chapters of this Treatise of New invented Chimneys.

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CHAP.

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FINIS.